

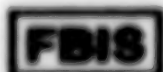
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West Europe Report

SCIENCE AND TECHNOLOGY

No. 36



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WEST EUROPE REPORT

SCIENCE AND TECHNOLOGY

No. 36

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CHEMICALS

USE OF COMPOSITES BY AIRBUS INDUSTRY, AEROSPATIALE

Welschenkirchen AEROKURIER in German Aug 80 pp 949-951

[Excerpts] A fiber as fine as a hair is about to revolutionize the entire aircraft construction industry. Whether helicopter, jet, glider or jumbo jet, to aircraft constructors of all categories the abbreviation CfK for the "carbon fiber/plastic" composite appears to be a type of "philosopher's stone." Advantages making the inconspicuous black fibers so valuable for aircraft construction, in particular, are: low weight combined with high strength and long life. Compared to steel, for instance, up to 70 percent weight may be saved with equal tensile strength. Even compared with the already classical CfK material there are considerable advantages to CfK, as may be seen from the construction of gliders.

Part of the modern CfK composite--the most important part--is carbon fiber. The "C" in CfK, while at the same time the chemical formula for carbon, shows the origin of this precious material. CfK further consists of synthetic resin, the so-called matrix, mainly on an epoxy basis.

The Godchild of Space Technology

Initially, CfK was not applied in aircraft construction directly, but in space technology. After that, the military started using it: spoilers, wing-tip strips and braking and landing gear flaps in the late 1960's. In the meantime there has been enormous advancement, particularly in the field of aviation CfK technology. Among other things, this led to aviation standards LN 29964 and associated standards. CfK technology achieved its greatest triumphs in gliding, however.

Using two examples which are representative of many others, we are going to examine the use of CfK in commercial aircraft construction according to the latest state of the art:

--Airbus A300 spoilers made of CfK, developed and built by VFW-Fokker GmbH, Bremen

--Rotor blades for helicopters SA 330 Puma, SA 365 Dauphin, and SA 342 Gazelle, developed by Aerospatiale, La Courneuve.

The 1.4m² Airbus A300 spoilers made of CfK serve the function of supporting aileron operation at all speeds. After touchdown during landing these spoilers, together with the air brakes, reduce the lift of the wings considerably and thus increase the braking effect of the aircraft. By using the CfK structural material, practical experience is to be gathered for use of additional CfK components in Airbus A300 and the smaller Airbus A310 construction. For VFW-Fokker the development of CfK structures is an area of concentration within their technology programs. The use of this composite component is seen from an economical aspect only. Efforts are made to reduce the Airbus operating costs by using this material. Compared to the conventional spoiler structure the use of CfK materials results in a 20-percent weight reduction. At the present time four CfK spoilers are being flight-tested in two aircraft of Lufthansa German Airlines. The components consist of composite Nomex combs with CfK cover layers. The outer bearing arms and the center power feed frame are massive CfK laminates jointed by gluing. The power feed is installed via titanium and aluminum fittings. No problems were experienced during several thousand hours of flight time using this material.

For years helicopter rotor blades for rigid and semirigid rotor systems have been manufactured from carbon fiber plastic with much success. As is well known, these components are among those which endure the most stress in aircraft construction and among those whose material and design have a direct bearing on characteristics, safety and economics. This is why the rotor blades of light to medium-size multipurpose helicopters, like Puma, Super Puma, Dauphin and Gazelle, are manufactured by using Rigilor carbon fiber structures. The construction is similar to that of the above-described Airbus A300 spoiler. So far some 3,000 rotor blades have been manufactured from CfK. To date, this component is thus probably the most frequently produced CfK component in the aircraft industry. All tests of this component over many thousand hours of flight time showed no problems. The material-specific advantages are as follows:

--Increased in-flight comfort due to improved vibration characteristics

--Increased initial mass depending on altitude and temperature. It was possible to increase the initial mass considerably with the same engine power, as compared to conventional aluminum rotor blades.

--Higher cruising speed particularly with high initial mass. (On 6 February 1980 an SA 365 N Dauphin II established a record speed of an average of 293 km/h with 10 passengers and a crew of 2 in bad weather conditions on the Paris-London-Paris route.)

- Noise abatement
- Increased surface shock resistance
- Fail-safe design, i.e. no expansion of any cracks or flaws
- Absolute corrosion resistance
- Minimum life of 3,000 hours flight time
- Increase in cell life due to reduced stress by the rotor system
- Reduced maintenance
- De-icing of rotor blades possible.

As indicated earlier, these examples are characteristic of many others. The use of CfK is becoming more and more topical, as the price of aluminum soars uncontrollably and the basic price of the carbon fiber can at least be maintained on a long-term basis. Taking into account all the facts, including the relatively high fiber costs, one must wish the new CfK composite a promising future.

9544
CSO: 3102

CHEMICALS

CHEMICALS INDUSTRY LOOKS TO R&D TO MAINTAIN MARKET POSITION

Frankfurt/Main FRANKFURTER ALLGEMEINE BLICK DURCH DIE WIRTSCHAFT in
German 30 Aug 80 p 1

[Article by Prof Dr Karl Heinz Buechel: "Research Secures the Future"]

[Text] Leverkusen, 29 August--About DM 14 billion were spent in 1978 by FRG industry on research and development, and of this roughly DM 4.5 billion was laid out by chemical industry alone. Why does a single industrial branch make these large expenditures?

All chemical products and processes have only a limited life; on the global scale there is always a displacement process underway. Hence the sales of an enterprise would already start to shrink after a few years if there were no development of new products and processes. An enterprise can maintain and raise its sales and thus secure its future only by means of continuously new developments.

In the case of the Bayer AG [in Leverkusen], about 35 percent of the turnover can at present be attributed to products and processes no older than 15 years--a clear indicator for the constrained life time of most market products. Thus research is a necessary investment in the future: In 1979, Bayer spent worldwide some DM 1.1 billion on research and development. A comparison with the volume of investment spending of the enterprise, which amounted to DM 2 billion in the same time period, indicates the significance attributed to the high-risk field of research. For 1980, a research budget of more than DM 1.2 billion is envisaged.

In the face of such relationships it is self-evident that in an industrial enterprise "investments" in research also have to be evaluated on the basis of economic criteria. A consistent documentation and review of the projects in regard to the anticipated rate of return, the degree of risk associated with them, the efficiency and ultimately the success of the research undertaking are as indispensable as are considerations of strategy in the determination of priorities and the provision of financial means.

The style of research and research priorities have strongly changed in recent years. Whereas in the 1950's and also at the beginning of the 1960's we were dealing globally with unsaturated markets, and the results of research and development would always be saleable sooner or later in one form or another (technology push), so that chemists had much latitude in their research, today research has to take its bearings much more from the market (market pull).

Besides this type of research oriented directly to the market we have basic research. Even though this is not oriented directly by market, it always stands in relationship to the specific activities of our enterprise. One of its tasks is to open up new classes of substances for our research on active substances.

Since the FRG is largely lacking reserves of raw materials and our labor costs by now are among the highest in the world, we must strive to develop such products and processes that require for their realization a high degree of scientific and technical know-how. In other words, we must do as much processing as possible on the primary materials we employ. Only in this way will we be able to maintain a situation which continues to offer us marketing opportunities in the face of the competition of countries which, on the basis of cheap raw materials and labor and low-cost capital, will soon be able to offer standard chemical products on much more favorable terms than we can.

It can be discerned already today that the innovations of the future will be found in those fields where chemistry interacts with physics, medicine and biology. Increasingly, our research and development undertakings will have to include scientists of other disciplines.

Another focus of research lies in the departments of applied technology. One of their tasks is to open up new applications for existing products. Their research mission also includes the solution of problems with the aid of existing products or combinations of products. For instance, in the past in petroleum extraction only 20 to 30 percent of the oil present in a deposit was raised, the rest remaining in the ground. By pumping in water under pressure (secondary extraction), which with the help of chemicals is optimally adapted with respect to viscosity and surface tension to the givens of the deposit (tertiary extraction), the yield can be raised to about 60 percent. The application of these new technologies substantially increases our exploitable petroleum reserves.

Research on protection of the environment is another important field of Bayer research which by now takes up about one-quarter of our research expenditures. Only part of this serves to reduce the environmental pollution generated within our enterprise. At least one-half of the outlays goes to the development of nonpolluting processes in the application of our products by our customers, to more profound investigations of existing substances or the development of new nonpolluting products for final consumers.

In the future, chemistry will to an even larger degree let nature contribute to its work. Micro-organisms and cell components, such as enzymes, are increasingly being set to work in the production of active substances for pharmaceutical purposes, for instance, but also for industrial chemicals. In the purification of sewage effluents, bacteria play a dominating role. The cultivation of certain fungal or bacterial strains, and biotechnology itself--which to an important part is process technology with subtle measurement and regulation techniques--require the collaboration of researchers of the most diverse disciplines. There is no doubt that biotechnology, which today is often tagged "soft technology," will experience a tremendous expansion in the future, especially if one thinks of the possibilities opened by genetic engineering.

9108

CSO: 3102

ENERGY

COMBINED NUCLEAR POWER, DISTRICT HEATING IN KARLSRUHE

Graefelfing ENERGIE in German Aug 80 p 328

[Article by Hans Gallenberger, graduate engineer, Nuclear Research Center, Karlsruhe]

[Text] There were perhaps indications in Karlsruhe: the subsequent removal of district heat from the multipurpose research reactor proved that nuclear energy and district heating can by all means be compatible partners. The technology was described in ENERGIE in June 1979, in the meantime the facility has delivered more than 700,000 GJ [giga'oules] of heat--without disruptions. Of course, the conditions in Karlsruhe are not transferrable to nuclear power plants in general, yet they are surely adequate cause for those in the directors' echelons of electricity supply companies to worry more about district heat removal. (Editors)

A heat supply from a nuclear power plant was realized for the first time in the FRG at the Nuclear Research Center in Karlsruhe (KfK). There, since the beginning of 1978, research facilities, institutes and office buildings which were originally heated by an oil heating plant have been supplied with heat from the multipurpose research reactor (MZFR) using the power-heat-coupling process. Removing the waste heat from the turbine condenser, for example with heat pumps, is economically impossible because of the design of the existing heat systems (feed/return temperature 130°C/90°C). The plant was designed in such a way that the maximum output is 20 MW_{th} if the amount of steam removed is 36 tons of steam/hour. If the maximum heating-water capacity is 425 tons per hour and the temperature spread in the heating water is 40°C, the original generator output of 57 MW_{el} is reduced by 4 MW_{el}. The thermodynamic cycle and thus the overall efficiency of the MZFR improves from 28.5 percent without heating operation to 32.5 percent with heating operation. The facility can be operated by the oil heating plant at base load (winter operation) with full output and meeting of

residual requirements and at partial load (summer operation) with variable output according to the consumer's heat requirements. The MZFR heating plant is connected in parallel with the oil heating plant so that grid operation with both heat sources is possible. In order to avoid the transfer of radioactive heat into the heating network, which would be possible only in the very unlikely event of simultaneous leakage in the reactor steam generators and the heating preheaters, redundant security equipment has been installed. Also, control measurements are constantly being taken.

Problems With Subsequent Installation

The KfK district heating example shows that heat removal from a nuclear power plant does not involve any insurmountable technical problems. Of course, the subsequent installation of the facility into an existing, functioning nuclear power plant would mean several problems of detail, especially in connection with the additional safety requirements and nuclear-legal questions of approval.

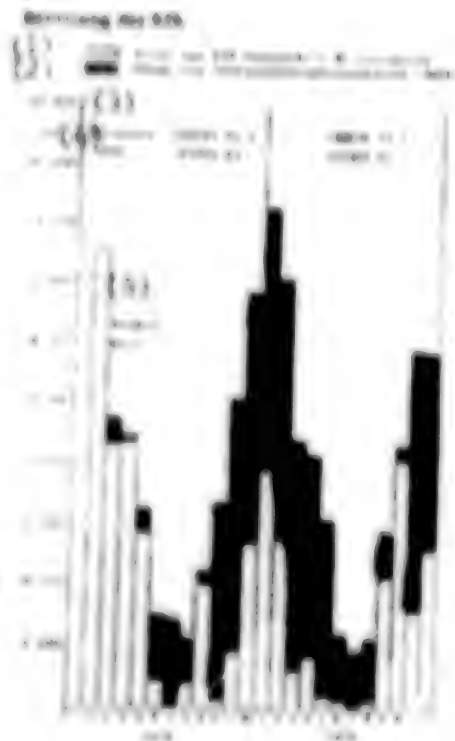
The facility, which is now entering its third winter, so far has functioned without any operational disruptions worth mentioning. By the end of July 1980 it had produced about 700,000 GJ of heat for the Nuclear Research Center.

Plant Will Be Amortized in 3 Years

The heat from the reactor helps the KfK save up to 10,000 tons of heating oil each year (this is approximately 75 percent of the oil consumption when there is full heating of the KfK oil heating plant). After deducting the costs of operation and the reduction in proceeds from power there are savings which will amortize the capital investment by the end of 1981.

This special example of a nuclear district heating supply, however, does not permit any direct conclusions about the economic use of district heating, since in this one the requisite reserve heating plant and the supply network are already in existence and there is a particularly high demand density.

On the basis of special marginal conditions and prerequisites, the nuclear district heating supply for Karlsruhe is by all means economical. In general, however, one must proceed on the basis of the fact that the economic use of district heating depends on very many marginal conditions such as high demand density, distance to the heat suppliers, structure of the supply region, and so forth.



Key:

Heating of the GFB

1. Heat from the GFB heating plant/A) oil equivalent
2. Heat from multipurpose research reactor (M2FB)
3. heating plant: 100,29 GJ/A) 100,636 GJ/A)
4. M2FB : 100,000 GJ 101,303 GJ
5. Test operation

17124

CSD: 1107

SECRET

GERMAN-AUSTRALIAN COAL-HYDROGENATION FEASIBILITY STUDY

Frankfurt/Main FRANKFURTER ALLGEMEINE ZEITUNG DIE WIRTSCHAFT IN
German 13 Sep 80 p 1

[Article by G1: "The Key Role Played by Coal: Australian and German
Cooperation for Coal Hydrogenation"]

[Text] Munich, 12 September--Coal will probably play a key role in future energy supplies. Experts at the World Energy Conference in Munich expressed this opinion when they discussed the question as to whether and how petroleum can be replaced. Coal liquification and coal gasification were given particular attention. As of today, there is no new procedure in sight for coal hydrogenation; all methods commonly used today date back to a procedure which was developed 50 years ago. But usage of these methods is not yet considered to be feasible in most countries.

Australia is an especially relevant example for studying the relevance of coal. In Australia, coal represents 81 percent of the total available energy reserves that can be mined feasibly and is nonrenewable, whereas crude oil only constitutes 1 percent. Coal and gas, as was expressed by country experts in Munich, will have to meet the largest portion of Australia's energy needs in the future: the annual growth rate in energy consumption is estimated at 3.8 percent there but the rate of increase in the availability of crude oil will only be 2 percent. More and more, Australia will have to cover its crude oil needs with imports from abroad, although conservation measures, for example in the use of automobiles, can be expected.

This necessity on the one hand and the proven large coal deposits on the other hand have led to the fact that Australia is very seriously considering the possibilities of coal liquification. In the papers which were previously written, a great deal of attention was devoted to studying the hydrogenation features of Australian coal and to searching for suitable locations for commercial plants. Together with the FRG, a study is presently being conducted under contract from the Australian government and three Australian provinces, namely New South Wales, Queensland and Victoria. This "joint Australian/German coal and oil feasibility study" is to be based on data from laboratory experiments and from pilot projects in which Australian coal was used. The objective is to establish the best technology for coal hydrogenation.

three especially suitable sites for the study were selected in Australia. A review is being made as to whether the commercial development of this project is technically and economically possible at only one or at all three sites. These measures were highlighted at the World Energy Conference as a good example of international cooperation and of combining resources on the one hand and technical know-how on the other hand. As a result, numerous countries can cooperate in order to promote certain developments as rapidly as possible.

In the FRG, as was pointed out at the conference, the use of coal would naturally be limited. Although the geological reserves in coal and brown coal constitute a total of about 250 billion tons of coal units in the FRG, it can be expected that the proportion of domestic coal to total energy supply will at the most be maintained but not exceed the present level of about 30 percent. For ecological reasons, an increase in brown coal mining to more than 15 billion tons of coal units is not considered possible. The current mining capacity of 90 to 100 million tons for coal could be increased but by hardly much more. Improvements in rationalization have become more difficult and it is difficult to obtain workers to mine black coal.

9529

C90: 3102

NEWS TO HAVE BEEN A FIRST OF AN POWERPLANT OF ITS KIND

Translation GERMANY: 7,00000 in Danish 28 Aug 80 p 17

Article by Peter Nilsen: Danish Solar Powerplant For 20 Million
[unclear]

[unclear] Denmark will probably be the first country in Europe to have a
powerplant constructed with hundreds of thousands of solar cells. The
power plant stations have now decided to follow the suggestion from the
Ministry of Energy to enter, along with other industries, into an EF-
supported project constructing a solar powerplant.

The project, which will cost around 20 million kroner total, will be pre-
pared to supply current to a small village. An enormous number of solar
cells will be erected on an area of 4000 square meters. The construction
of these solar cells is reminiscent of the photo cells which, among other
things, are used for opening automatic doors. When lit, each cell gives
off a little current; and with all cells combined, the project should
yield about 20 kilowatts; enough to supply electricity to 10 houses.

As it is of interest to build such a pilot project here, despite the
weather in Denmark, the fact remains that the colder it is, the better
these solar cells function.

Both of the two power companies, Elsam and Aikraft, are contributing
half a million kroner for the final project. Other industries, Siemens
A/S and Dansk Energi Teknik A/S among others, support the project which
is also expected to receive support from the German and Danish energy
ministries, if the EF-solar energy program can grant support of up to
10 percent.

All the pieces have not fallen into place yet. At the moment it happens,
however, then the power companies will start searching for a suitable
site for the powerplant. What is needed is a place where there are enough
sun hours; a place close to a public highway which will provide an easy
approach to the power net.

Along with the fact that the plant will probably be the first of its kind
in Europe, it will also be the most expensive. If all goes according to
plan, the power companies expect to invest about 2,500 kroner per kilo-
watt. The investment in the solar plant will be 1 million per kilowatt.
No heating expense will be the reward.

ENERGY

METHANOL FUEL STUDY UNDER WAY

Stockholm SVENSKA DAGBLADET in Swedish 21 Sep 80 p 5

[Article by Anders Rultman]

[Text] Tomorrow, (Monday) the first step in Sweden's efforts to develop a new automobile fuel--methanol--will be made public. It is an effort toward cleaner air, but it is also a very controversial effort. Today, SVENSKA DAGBLADET will give some background information.

Study

Sweden must save oil and invest in fuels that can replace it. This is the starting point for the work of the Oil Replacement Commission (OED).

The OED has created working groups to study five oil replacements:

Coal

Forest waste

Peat

Synthetic fuels

Solar heat

Last June the fuel group presented its conclusions and during the same month the OED presented its recommendations: an investment in methanol as the most realistic alternative.

"Methanol can be introduced in limited, but not insignificant quantities, to the present transportation system without all too sweeping changes. It has a very high developmental potential (100 percent methanol operation) and at the same time conditions can be found for domestic production based on renewable resources in the long run."

The OECD recommends that the government make a final decision during 1984. "The introduction of methanol in practice on a more comprehensive scale should be under way in 1986-1985."

Trial

Tomorrow, the full-scale Swedish project with 95--a mixture of gasoline and 5 percent methanol--will be presented.

Around 20 gas stations throughout the country will carry the fuel, in which the gasoline is unleaded. Around 1,000 cars will participate in the project.

It is estimated that the project will cost 16 million kronor, which will come primarily from public funds. The two participating oil companies, Swedish OK and Nynas, are contributing a total of 2.9 million kronor.

The project coordinator will be Svensk Metanolutveckling AB, the "Methanol Company," a company formed by the state and Volvo in 1975, in which the state owns 90 percent.

Supply

At present, methanol cannot be produced in Sweden. It must be imported and the most probable raw material up to the year 1990 is natural gas.

Four Swedish firms have decided to form a joint company for importing methanol: OK, Nynas, Svenska Petroleum and Volvo Energi. The methanol is to be produced at a plant in Holland, which has not yet been built, using natural gas from Norway.

Criticism

The international oil companies have not been given the chance to participate in the large-scale Swedish project. "We are accustomed to discrimination against certain segments of Swedish industry," Svenska Shell's managing director Alf Bergman says. "But we have not been interested in participating, either."

Alf Bergman also says that investment in methanol is occurring without a clear definition of what advantages will be achieved.

"Methanol is not a domestic fuel and it does not increase the security of our fuel supply in case of a cutoff," he says.

"The amount of gas in the North Sea will not be increased by making methanol out of it (the gas could just as well be used in the European gas network) and the additional fuel obtained is less than the amount already in emergency storage."

The decision to carry out the large-scale Swedish trial project with a mixture of methanol and unleaded gasoline is being criticized by the Automobile Industry Association, which represents all Swedish and foreign automobile manufacturers.

Only half the new cars sold in Sweden today can operate on unleaded gasoline--the rest need the lubricating effect on the valves and valve seats.

Thus, a number of automobile manufacturers would have to build special cars for Sweden if the unleaded test fuel also receives final approval.

On the other hand, automobile manufacturers in the United States and Japan could sell cars to Sweden without the modifications they are forced to make today. Thus, there are large economic interests opposing each other here.

Europe

Throughout the past year, the Swedish auto industry and the foreign industry represented here have strongly criticized Sweden's special regulations regarding automobiles. The Swedish regulations concerning exhaust purifications differ from those in Europe--they are tougher--while the United States and Japan have stricter requirements. The Swedish auto makers have stated that adherence to the EC exhaust regulations is necessary for survival.

The reaction can be expected to be sharp against Sweden's now choosing a different route than Europe's leading industrial nation, West Germany, when it comes to the alternative fuel methanol, even though this is being done on a trial basis.

In West Germany a trial project is under way with 1,300 cars using fuel mixtures. Over half are operating on the M 15 mixture, but with 0.15 grams of lead per liter of gasoline included in the mixture.

Dangerous?

The environmental aspects have been of great importance in the investigation of methanol as an alternative fuel. The fuel study group says that operation with pure methanol is considered to provide certain advantages over gasoline: less carbon monoxide, nitrous oxides, polyaromatic hydrocarbons and soot. The fuel mixture provides no great advantages, they say, since such a large portion, over 80 percent, is still gasoline.

"A considerable advantage to the environment can be achieved if the fuel mixture employs lead-free gasoline."

Warnings

Thus far, the country that has made the most use of alcohol as a fuel replacement for gasoline is Brazil. There, however, automobiles operate on another, closely related, alcohol, namely ethanol.

At present the fuel mixture here is gasoline with 20 percent ethanol, but the Brazilian auto industry has assumed the task of building 900,000 new cars in 3 years for operation on pure ethanol (and converting 270,000 for the same purpose).

However, Professor Eric O. Stork, the man behind American exhaust purification, has encouraged the Brazilian authorities to be attentive to the increased discharge of aldehydes, which accompanies methanol and ethanol operation and to give priority to measures for combatting them in the large cities.

Researchers in Sweden have also spoken up. Some warn that there is an increased risk of cancer and changes in the hereditary factors when a mixture of gasoline and methanol is used.

Villic Anders Laveskog of the Environmental Protection Agency is an expert member of the fuel study group.

It is necessary to distinguish between methanol's toxicity before it is burned and during combustion, Anders Laveskog stresses.

"Before combustion it is less toxic than any other fuel, such as gasoline, for example. The limit value of methanol is also lower than that of gasoline."

"The methanol-gasoline mixture is more irritating on the skin and that is good, since skin contact is to be avoided."

"But the most important prospect with the methanol mixture is the possibility of using unleaded gasoline. Ethylene dibromide and ethylene dichloride, which are always found together with the lead, have both proven to be carcinogenic and mutagenic in experiments with animals (i.e. they have been shown to alter genes).

After combustion, study results are more uncertain. It has been stated previously that the aldehyde contents increase. Some researchers have produced decreased contents, but let us say that the total amount increases, primarily formaldehyde.

"I have adopted a wait-and-see approach to the report of the increased risk of cancer due to formaldehyde discharge," Anders Laveskog continues: "Experiments have been carried out with very high percentages, 15 ppm (15 millionths), while 1/5 ppm is the highest figure in "normal air."

Tobacco smoke contains 40 ppm formaldehyde, as does automobile exhaust and, for example, particle board.

"Also, we must not forget that some people are allergic to formaldehyde," Anders Laveskog concludes.

This fall all research results will be compiled for a "comparative national assessment" of what methanol will mean for Sweden's air and environment.

9336

CSO: 3102

ENERGY

GROWIAN II WIND POWER PLANT TO HAVE 5 MW CAPACITY

Duesseldorf BWK: BRENNSTOFF-WAERME-KRAFT in German Jul 80 p 262

[Text] Since 1978 the Messerschmitt-Boelkow-Blohm Co has been developing a large wind power plant for the generation of electric current under the name "Growian II." The nuclear research station at Juelich is supporting the project, which was commissioned by the ministry for research and technology. The rotor span of the planned installation, which is designed for an output of 5 MW, is 145 meters, the maximum height of the entire plant is 194 meters, photo. According to a statement from MBB, the technologically maximum limit of this concept has not yet been reached: wind energy plants with an output of more than 5 MW seem to be quite feasible.

Description of the Plant

Growian II is designed to feed into an existing power grid and works in a wind velocity range between 6 and 20 m/sec. The design capacity of 5 MW is achieved at a wind velocity of about 11.3 m/sec at hub height (about 120 meters). At wind speeds higher than 11.3 m/sec, up to the cut-off speed of 20 m/sec, plant output is kept constant by reducing the pitch of the blade. With an average wind speed of 9 m/sec at hub height--equivalent to conditions along the German coast--annual energy production exceeds 20 GWh.

The principal feature of MBB's concept for Growian II is a single-blade rotor. In contrast to twin or multi-blade rotors it is possible to use a less complex rotor head. The rotor of the wind energy plant will rotate at 16 to 18 revs/min. This corresponds to a blade tip speed of about 130 m/sec. If wind direction changes, the gondola at the top of the tower containing the gears and the generator yaws automatically with the rotor, which functions as a downwind vane. The cylindrical steel-reinforced concrete tower, braced by three guy wires, is 3.5 meters in diameter and about 120 meters high. The weight of the entire plant, including tower, gondola and rotor will be in the region of 1,250 tons, about 100 tons of that being the rotor.

A one-third plant, with a rotor span of about 48 meters and an installed output of about 350 kW, is supposed to be in operation in Bremerhaven in the spring of 1981. Valuable additional operational experience will be gathered with this plant before construction of the full-scale plant.

Model of the planned wind energy plant Growian II



9581

CSO: 3102

ENERGY

GOVERNMENT COLLECTS OPERATING DATA ON WIND POWER PLANTS

Bonn DIE WELT in German 5 Sep 80 WELT REPORT Supplement pp 30-33

[Article by Jens Farrell: "Only He Who Sows the Wind Will Reap Kilowatts"]

[Text] With his high home heating oil bill in his hand, many a citizen is now dreaming the dream of supplying his own energy, the dream of the power which, for centuries, supplied our daily bread, helped in land reclamation and pumped water out of the ground: windmills to generate electricity. On the small North Frisian island of Pellworm this ideal has become a reality. Nine wind power plants of different sizes have been spinning since 27 June under a contract from the Ministry for Research and Technology.

It is not by chance that Pellworm of all places was selected for the location of the wind dynamos. The island lies in one of the few regions in the FRG with favorable wind conditions. The wind blows steadily here on the very edge of the North Sea coast, fairly constant wind velocities between 6 and 7.5 m/sec are recorded.

This large-scale experiment to transform the wind into energy is to run for two years. The Geesthacht Research Center (GKSS) has taken charge of the project. The purpose of the test is to establish the reliability and the required maintenance costs of the wind power plants in continuous operation. In addition, a series of characteristic figures will be measured and compared by the GKSS, so that data about the yield of each individual installation as a function of the available wind, the investment cost per kilowatt and the price per kilowatt hour generated can be calculated exactly. The GKSS says: "These figures will be converted subsequently for various applications and used in evaluating a particular installation."

For this numerical puzzle each wind dynamo is equipped with a calculator for measurement and control. It determines the voltage and amperage delivered by the generator, electrical output and the electrical energy produced, and it registers the alternating current frequency and from it the revolutions of the rotor.

The central data collecting system processes and stores the figures obtained, so that they can either be read off on site or transmitted by telephone to the computer center of the GKSS.

For the long-term test one Danish and eight German plants were selected, which attain an electrical output of 4 to 11 kilowatt hours at a wind velocity of 8 m/sec.

In terms of a normal household this means: a single 10 kW wind dynamo can light ten 100-watt light bulbs or run a dishwasher plus an electric stove. In straight numbers all nine installations together produce 85 kilowatt hours. The output expected from Growian 1 is a couple of sizes larger: the largest wind powered generator in the world will produce 3 megawatts of electrical power after 1983.

The super wind dynamo is being built under a commission from the minister for research on the Schleswig-Holstein coast--in the path of the shifting low pressure areas near Marne. Three major electricity suppliers from Hamburg, Essen and Rendsburg are the owners.

At the moment Growian exists only on the drawing board and as a model. The latter is now in the Marne Savings Bank in Brunsbüttel. Interested visitors can learn technical details from a tape recording. If they wish even in Plattdeutsch: for example, the wind power plant measures 150 meters from the tip of the rotor to the base. That is 18 meters more than Hamburg's symbol, the "Michel." The twin-bladed rotor has a span of 100 meters, the tower cabin with the machine housing is free to move on the shaft and turns with the wind. Groundbreaking is planned for December this year. Construction time is set at three years.

The 50 million-mark project will not deliver bargain priced current however. Growian, like its little brothers on Pellworm, is primarily intended to collect operating data and thus facilitate later decisions about weather and how wind plants of this size can contribute to providing energy.

To be sure, optimists already see the solution to all our energy problems in the "Growian age." But the twin-bladed giant is fickle. In a calm or a storm it stands motionless.

When the wind is blowing with a velocity of between 4.5 and 10 m/sec., it achieves an output of about 3 megawatts. For comparison: a normal generating station produces 100 to 1,300 megawatts.

Wind energy is converted in Growian's generator into three-phase current and is fed directly into the power grid. Variations in rotational speed caused by fluctuations in the wind striking the blades consumer up to 15 percent.

The owners of Growian are counting on an average annual energy output of 12 million kilowatt hours. Theoretically this yield could provide 4,000 households with electricity for one year or meet the electrical needs of 250 single-family dwellings including heating.

However impressive this calculation may appear to be--to replace the Stade nuclear power station, for example, the North German coast would have to be covered with 200 wind powered installations of the Growian type. An idea that would encounter bitter resistance about all from environmentalists. In the opinion of the GKSS, German technology in "grinding" energy from the wind currently occupies one of the leading positions in the world rankings.

9581

CSO: 3102

ENERGY

FIRST FULL-SCALE WIND POWERPLANT TO BE BUILT

Stockholm SVENSKA DAGBLADET in Swedish 18 Aug 80 p 12

[Article by Per Erik Landqvist: "First Wind Powerplant To Be Built 1981"]

[Text] Trelleborg (SvD). About one year from now an 80 meter high tower for Sweden's first full-scale wind powerplant will be erected.

The tower will be built in Karlskrona and will cost 70 million kroner. The tower will be constructed in Maglarp right outside Trelleborg, which is, according to the National Meteorologic and Hydrographic Institute (SMHI), Sweden's "windiest spot by far."

The powerplant will start operating 28 February 1982, and will operate on trial basis for 2 years. In 1984 an evaluation, which may lead to further construction, will take place.

Sydskraft has made preliminary arrangements to begin building in Maglarp 1 September.

--It is a matter of clearing the site so we can start pouring the concrete for the foundation of the wind powerplant, says Per-Olof Ekblom, project manager for Sydkraft in Maglarp.

Since November last year SMHI has had 120 meter high steel tower placed in Maglarp in order to measure the wind velocity in Soderslatt.

--It has been unusually windy. More than we hoped for during the six months of winter, says Ekblom.

The Committee for Energy Production Research is supporting the wind power project by backing two full-scale "mills." Aside from the one that Sydkraft is building in Maglarp, another one will be built at the Burgsviken on Gotland.

The two wind powerplants--which will have 45 meter long propellers--will produce 3,000 kilowatts during the windiest periods around Skane and Gotland.

In principle, each wind powerplant should be able to heat approximately 300 one family houses

--Perhaps one should not compare nuclear power with wind power. Nevertheless, it should be pointed out that a wind powerplant yields approximately one-thousandth of what we get from the Barseback plant, for example, which is a small hydro powerplant in South Sweden, says Ekblom.

It is always costly to build an experimental plant. The cost of building the wind powerplant in Haglarp will be close to 70 million kroner.

But if it turns out to be a chain undertaking--Hydkraft has been commissioned to search further for 10 windy spots on par with Haglarp--then the cost can be reduced to 10 million per wind powerplant.

Then Sweden can benefit from the deal the Karlskrona shipyard is working on now by selling wind powerplants to the United States.

9583

CSD: 3102

ENERGY

GROUNDBREAKING FOR FIRST FULL-SCALE WIND POWER PLANT

Stockholm DAGENS NYHETER in Swedish 16 Sep 80 p 12

(Article by Be Engzell)

[Text] The wind's power was at its best Monday (winds of around 15 meters per second) when the ground was broken for Sweden's first full-scale wind power plant. It is now being built at the windiest spot in the country--Maglarp, outside Trelleborg. Now that construction of the wind power plant is beginning, Karlskronavarvet expects a brighter future. The shipyard will deliver towers and machine housings to wind power plants in both the United States and Sweden. Jobs at the shipyard will be created.

Two wind power plants will be built in Sweden by the Board of Energy Production Research (NE), the first in Maglarp and, soon afterward, the second at Nasudden on Gotland. Later, when the plants have been in operation for a time and checked by various computers, they will be evaluated. After that, it will be up to the politicians to decide how many wind power plants Sweden should have. Of course, decisions cannot be made before the people have had their say, among other things from an environmental point of view.

"I do not believe the farmers in this region want any more wind power plants in addition to the one in Maglarp," town councilman Borje Jonsson says. The farmers prefer to have the wind power plants built at sea, in shallow water of course.

However, Trelleborg hopes the Maglarp plant will become a tourist attraction, with a restaurant or cafeteria.

Beside the two prototypes now under construction, additional large wind power plants can be built in Sweden by 1985 at the earliest, says Per-Ola Ekbon of Sydskraft, project leader in Maglarp.

Motor of Plastic

The two experimental plants will be built differently. The one in Maglarp, which will be built a little before the other one, will begin operating in early 1982. It will have a steel tower 80 meters high, which will be delivered by Karlskronavarvet. The rotor with a diameter of 78 meters, will be made of glass fiber

reinforced epoxy plastic. The Gotland tower, on the other hand, will be built of concrete with a steel rotor. In this way, different types of technology may be compared.

The Maglarp plant will have a rotor blade a total of 120 meters high. It will be built on a hill on the plain near Maglarp's typical Scanian church. The cost of the Maglarp project will be 70 million kroner. The Gotland construction will be somewhat cheaper.

"Because of all the research, the electricity delivered by the prototype plant in Maglarp will be expensive, 1 krona per kWh," project leader Per-Ola Ekblom says.

However, Sydkraft has calculated that, if series production of wind power plants is later carried out, the cost of electricity will drop to between 20 and 30 ore. According to Karlskronavarvet, which will produce machine housings and towers, and which has assumed the task of delivering a ready-to-operate wind power plant, the cost may drop all the way down to 15 ore per kWh.

For wind power to achieve any great significance in Sweden, many plants must be built, in groups of 10 to 100. Maglarp, with a capacity of 3,000 kW, can provide electricity, including heating, for only 300 single-family dwellings!

"Wind power can only complement other energy forms and replace a portion of the oil," Per-Ola Ekblom believes.

In the United States, it has been estimated that wind power can provide at most 10 to 15 percent of the energy supply. Swedish experts have arrived at similar figures.

The wind must blow 5 to 22 meters per second for the wind power plant to be driven. The best wind velocity is 14 meters per second. Thus, conditions at Maglarp on Monday were ideal. Maglarp is the windiest spot in Sweden. Half the hours during a year have winds over 8 meters per second.

Wind power plants should preferably be built in windy southern Scania, but Öland, Gotland, and some places along the west coast, as well as a very limited region of Uppland are also suitable, according to measurements.

Karlskronavarvet has high hopes for the future of wind power plants, for which it can produce towers and machine housings. The company has already made a delivery to the United States.

"We are hoping for more orders, including an entire group for a project on Hawaii," says the shipyard's financial manager, Hans Johansson. "Sweden will also build many more plants. This could provide jobs for perhaps 150 workers at the shipyard and make a significant contribution toward employment, as far as we are concerned and wind power should be able to complement Sweden's energy supply."

The old windmills of the southern plains must give way to the future, streamlined wind power plants, which will be many times as high. That is, if environmentalists and farmers approve.

ENERGY

BRIEFS

EEC PHOTOVOLTAIC POWER PLANTS--More than a dozen solar electricity generators of the photovoltaic type, with an output of 30-100 kw, will be installed in Europe, on a cost-sharing basis, by the EEC in collaboration with the national governments, the electric power distribution companies, industry, and other organizations. These installations will have a total capacity of about 1 Mw and will be finished by the middle of 1983. They are designed to test the electric power production system based on solar energy in Europe. This program will also make it possible to make the solar energy electrification projects more credible in the developing countries by constituting the technological base necessary for these projects. The solar installations will be selected from among more than 30 proposals received during the month of May by the EEC Commission. It is expected that, basically, one installation per month will be built in each member country, including the Scandinavian countries; this is possible now due to the fact that solar cells are functioning effectively not only under direct sunlight but also when there are clouds, when there is rain, provided there is a little bit of light. In many cases, the solar generators will be installed on islands where electric power generation by conventional means is not always easy. [Text] [Paris SEMAINE DE L'ENERGIE in French 1 Sep 80 p 8] 5058

KLOECKNER COAL GASIFICATION PLANT--According to the West German press, the Kloeckner Group has proposed the construction, at Bremen, of a coal gasification plant capable of processing 2.5 million tons per year of imported coal. The energy thus obtained will be used, half by the steel mill itself while the rest will go to the city of Bremen. The final decision is to be made in October. The project's cost comes to DM 6 [as published; million?] for which West German government subsidies might be requested. [Text] [Paris SEMAINE DE L'ENERGIE in French 8 Sep 80 p 8] 5058

CRO: 3102

INDUSTRIAL TECHNOLOGY

MATERIALS TO BE MADE IN SPACE, AUTOMATICALLY

Paris L'AERONAUTIQUE ET L'ASTRONAUTIQUE in French No 82, 1980 pp 3-10

[Article by R. Serradell, in charge of the Minos studies at the Office of Programs of the National Center for Space Studies (Paris), R. Torossian, in charge of the preliminary Minos Project at the National Aerospace Industrial Company (Les Mureaux) and N. Donaulan, in charge of the preliminary Minos Project at the MATRA Vehicles Company (Vélizy): "Minos: Space System for the Industrial Production of Materials in Orbit"]

[text] Introduction

Following the age of space research, in the course of which substantial funds were invested in research and development in the United States and the USSR and, to a lesser extent, in Europe, today we are in the age of the application of space on the level of "operational services": telecommunications, meteorology, direct television and, soon to come, various uses of ground observations.

The National Space Studies Center has included in its future plans the manufacturing of materials in orbit as one of the new and most promising applications which could inaugurate before the end of the century the era of the "industrial" use of space. We have used this adjective to describe a profound change in the use of space since, in that case, it would be a question of the following:

--Significant production of materials, i.e., an output which would have a major impact on the economic level;

--An investment of space facilities (automatic orbital station and a shuttlecraft) which, following the demonstration stage, will require the financing of private industry involved in the marketing of goods "made in space," which would consider operational costs and the developments which will complement the operational phase.

Furthermore, this theme offered two advantages:

--On the one hand, it seemed, at a first glance, to be within reach of the European space industry (technologies, means, and the nonrequirement of the presence of man in space);

--On the other hand, the topic was consistent with the automatic station to be designed. Thanks to the modular approach to its design, this made possible the repeated utilization of this platform.

The acronym Minos, given to this draft project expresses its objectives: "Modules for Industry and Observation in Space."

Performance Targets of the Minos System

The purpose of the Minos system, therefore, is the industrial production of materials in space aboard a fully automated station.

Given the current stage of research in the manufacturing of materials under microgravity, it was not possible to select a family of materials to be produced in space or to suggest a typical manufacturing procedure. A number of research lines seem promising (superconductors, magnetic materials, semiconductors, pharmaceuticals); the feasibility of the production of such goods cannot be proved with certainty before the conduct of elaborate and repetitive experiments starting as of 1983 based on the European and American flights of the Spacelab Orbital Laboratory. Furthermore, it would have been unrealistic to speak today about the market for such potential new materials or about the economic interest in producing them.

Nevertheless, it is certain that space metallurgy will require a substantial amount of electric power covering a long manufacturing cycle as well as high temperatures. Therefore, the following working hypotheses have been retained as an interface between the treatment plant and the orbital station:

- available electric power: 10 kilowatts;
- duration of the processing cycle: 10 hours;
- residual acceleration during the cycle: $10^{-5}g$;
- thermal dissipation to be maintained: 6 kW at 700°C; 3 kW at 100°C; 1 kW at 40°C.

Before concretizing the draft project it was assumed that the material to be processed would be shaped as 1 meter long 50 mm thick rods and that the treatment will take place in a floating-zone furnace at a temperature of 1,500°C; annual output was estimated at about 10 tons.

Table 1. Ariane Payloads (kilogr) for Circular Orbits of Interest to Minos

| Altitude | (1) Orbits equatoriale | | | (2) Orbits heliosynchrone | | |
|------------------------|------------------------|--------|---------|---------------------------|--------|---------|
| | 600 km | 800 km | 1000 km | 600 km | 800 km | 1000 km |
| Inclination (3) | 0° | 0° | 0° | 97.8° | 98.8° | 99.9° |
| ARIANE II | 4250 | 3800 | 3250 | 3270 | 2890 | 2470 |
| ARIANE III | 5100 | 4500 | 3850 | 3960 | 3550 | 3090 |
| ARIANE IV | 6200 | 5600 | 4930 | 4640 | 4380 | 3850 |
| ARIANE V tri-stage (4) | 9090 | 8330 | 7510 | 7270 | 6680 | 6040 |

Key: (1) Geostationary orbit (3) Inclination
(2) Heliosynchronous orbit (4) Ariane V tri-stage

The launch vehicle was the Ariane rocket with its spinoffs up to Ariane V (Table 1 gives the performances of the different versions for the orbits of interest to the Minoa project).

The materials were to be recovered in Guyana on a strip of land 5 by 10 kilometers in size. The option of "recovery at sea" in the Gulf of Gascony was also considered.

Finally, the Minoa space station was to have an active life of at least 7 years. Possibilities for repairs while in orbit through telemetry were to be included in the design of the system.

Therefore, it is on the basis of a study which took 1 year conducted by the CNES with two parallel 6-month contracts assigned to industry (Snias and Nitra), along with a theoretical study of the reentry and recovery aspects assigned to the ONERA.

Basic Studies

The first 3-month-long phase of the two industrial contracts covered essentially a study of functions and subsystems determining the choice of orbit and the configuration of the system, as follows:

- energy: solar generator and possible storage (geostationary orbit) of the energy aboard the station;

- stabilization: selection of a type of attitude control respecting the constraint of microgravity (corrections for maintenance in orbit to be made between processing periods);

- meeting between the station in orbit and the shuttle craft which brings raw materials and insures the recovery of the processed materials: Study of the procedure and the coupling system;

- atmospheric reentry of the shuttle craft and recovery of the materials: Types of reentry and precise recovery;

- repairs through telemetric control of spare equipment blocks: Determining the state of the art in matters of robotics and initial approach to the problems.

The conducted studies made it possible to identify the most critical subsystems and technologies but did not result in the detection of unmanageable difficulties in Europe within a 10-year period.

In its Ariane III version, the Ariane launcher proved to be adequate to put into orbit a station which would provide the necessary services and the related processing plant. It would also easily make possible the launching of the craft which will shuttle between Guyana and the orbital station with a payload of over two tons, or five launchings per year, hauling materials to be processed in orbit and possible replacement equipment for the station.

Considering the difficulty of involving at the current stage the economic aspect of the system, the choice between geostationary and heliosynchronous orbits is not mandatory. Whereas the former allows a substantial increase in the payload (50 percent) and, therefore, a lesser cost of the materials processed in space, it suffers from the inconvenience of needing energy storage (1 eclipse per orbit) and requires twice the number of solar panels. Conversely, a 6-18 hour heliosynchronous orbit at an altitude of about 800 kilometers has the advantage of constant solar light for most of the year and allows a coverage of the globe of interest to other station users such as ground observation or data gathering.

The following results pertain to the main station subsystems:

- energy: the use of large solar panels and storage, in the case of geostationary orbit of 10 kilowatts per magnetic block or in nickel-hydrogen batteries;

- triaxial stabilization (one of them directed toward the ground) with the help of reaction wheels desaturated by the gravity gradient couple.

Theoretically, the joining and coupling operations pose no problems. However, ground experiments should be conducted to establish technologies and procedures.

The ballistic reentry offers three possibilities which are under study:

- a reentry with a purely ballistic trajectory with high deceleration (25g);

- a semiballistic vehicle of the Apollo-type which would have a maneuvering possibility used to improve the precision of the landing point on the ground but would require an on-board guidance system;

- a space gliding-type vehicle which would make a precise soft landing possible.

The first of these solutions, which is more "primitive" and less expensive (no guidance system) seems to be the most suitable for Minos whose transportation costs should be reduced to a minimum since they play a determining role in the price of "made in space" materials. The ONERA and Snia studies have shown that the precision recovery conditions could be met.

Finally, the "robotics" needed for handling the materials aboard the (automated) orbital plant and for possible repairs in orbit (programmed or remote-controlled from the ground) would require new developments in industry. Nevertheless, we should note the major progress made in France, particularly at the CEA (the Vertut Laboratory) and Renault Automatismes.

The sum total of these basic studies, therefore, shows the overall feasibility of Minos as a space system, whose development and implementation would require 8 to 10 years. Naturally, this does not eliminate potential difficulties related to the development and completion of the "treatment plant" modules.

Architecture of a Minos System

The second stage of the study conducted at Sniase dealt with the draft plan for Minos system which, using "current" technology, could be developed on a medium-term basis the moment possibilities for the manufacturing of materials in space would be confirmed.

In order to achieve specific results on the conceptual level within the time allocated for the study, a certain number of choices were temporarily made, particularly those of a station in a geostationary orbit and a purely ballistic reentry.

Structure of the Minos System

The system includes the following elements:

- a low orbit platform (Figure 1) consisting of a service module (stabilization, energy, telecommunications) and a "processing plant" module with a related remote-control subsystem;

- a shuttle craft (Figure 2) launched with an Ariane rocket which would deliver and recover the materials;

- optionally, a telecommunications satellite to relay data transmissions (remote-control handling in particular).

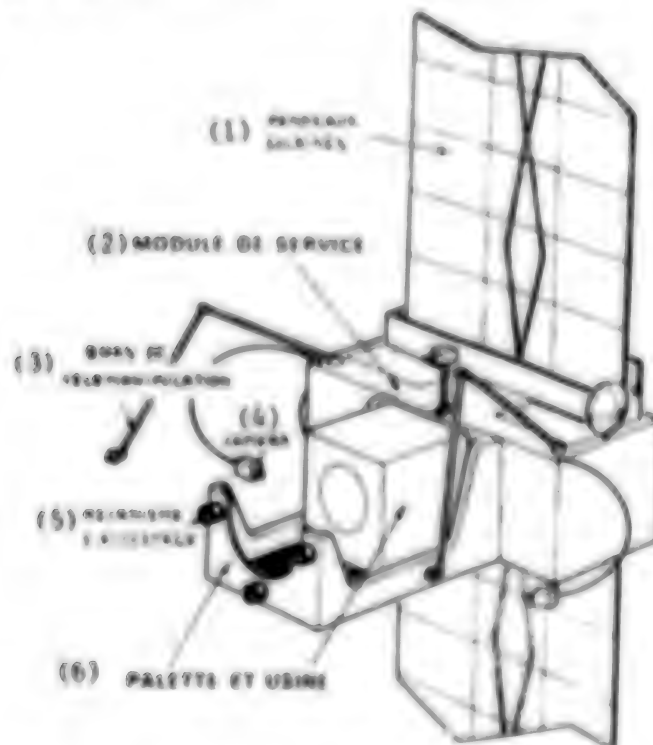


Figure 1. Minos orbital station (SNIAS draft project)

Key: (1) solar panels (4) camera
(2) service module (5) docking mechanism
(3) remote-control handling arm (6) pallet and plant

Service Module of the Minus Orbital Station

This central element of the automatic station is shaped like a parallelepiped. Its dimensions are about 2 x 2 x 4 meters. It is launched (see stages on Figure 3) by an Ariane III rocket on an 800 kilometer equatorial orbit at a 5 degree angle. Once in orbit, 2 very big solar panels (35 meters long and 4 meters wide), capable of generating 24 kilowatts for the duration, are deployed.

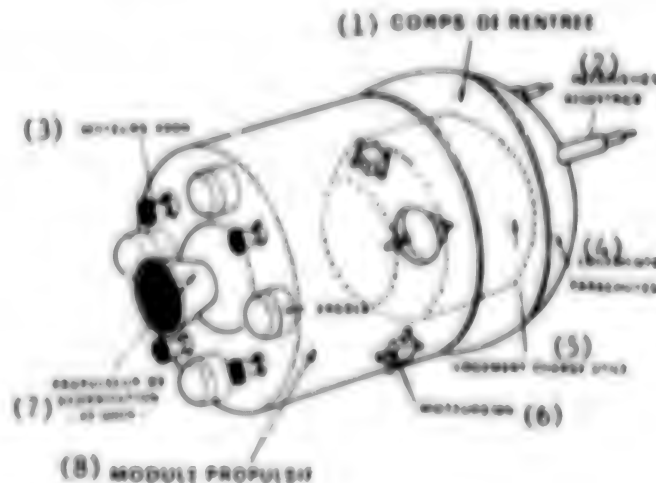


Figure 2. Shuttle craft (SNIAS draft project)

| | |
|-----------------------|---|
| Key: | (5) payload housing |
| (1) reentry part | (6) 10N engines |
| (2) docking mechanism | (7) deorbiting propulsion mechanism (40,000N) |
| (3) 4000N engines | (8) propulsion module |
| (4) parachute housing | |

During the processing of the materials in the "plant" module, or in the course of a period of no more than 10 hours, the stations should supply 10 kilovolts of DC current and insure a stabilization compatible with the very weak level of acceleration on the platform ($10^{-3}g$).

A combined system of stabilization and energy storage, based on high-speed kinetic wheels is suggested. It will consist of three pairs of counterrotating wheels used at two-thirds of their maximum power, thus insuring a reliability appropriate to the storage function and maintenance of the stabilization function should three wheels break down. The system will not have any gas ejection in order to limit accelerations and avoid keeping the station supplied with propellants. The desaturation of the kinetic wheels is achieved thanks to the gravity gradient couple.

A structure known as a "pallet," 2 x 3 meters in size, is hooked on one of the major faces. It is used as a standard mechanical interface for the placement of the various "plant" modules which could be successively used in accordance with the type of material processed.

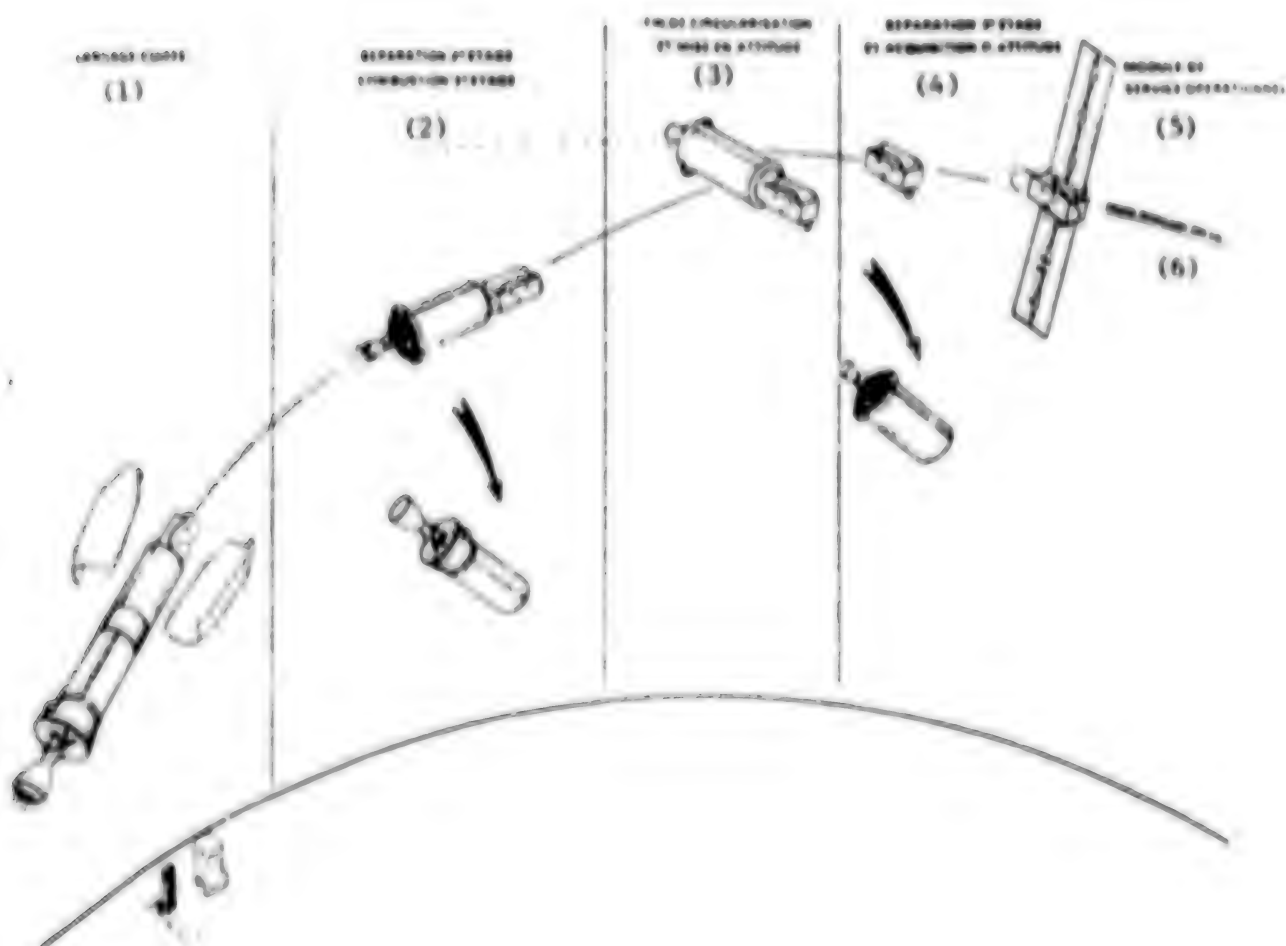


Figure 3. Putting the service module in orbit

Key:

- | | |
|---|--|
| (1) release cover | (4) separation third stage and positioning |
| (2) separation second stage, firing third stage | (5) service module operational |
| (3) end of circling and positioning | (6) 800 kilometer circular orbit |

The pallet and the first "plant" module are put in orbit and assembled on the orbital station with the help of a shuttle propulsion module.

Finally, the figure showing the service module shows what the subassembly for remote handling might look like, with two articulated arms equipped with grips, a fixed camera and two mobile cameras. Such robotic equipment could perform multiple functions: positioning and exchanging plant units on the pallet, loading and unloading the containers with materials brought by the shuttle craft, assisting the shockless docking and, finally, making repairs in orbit by exchanging complete equipment blocks (such as, for example, a pair of kinetic wheels or a battery block). Considering the very general nature of the present study, this subassembly has not been the subject of a design study.

The mass of the orbital station will be 2,200 kilograms for the service module and 1,000 kilograms for the "pallet plus plant module" set.

The Shuttle Craft

This is not a transport system comparable to the American "shuttle" but, more simply, an assembly consisting of a propulsion module and a reentry part. This assembly is put into a rendezvous orbit with the help of an Ariane rocket.

The propulsion module performs various functions:

- makes possible the rendezvous with the station and the docking maneuvers, using four bi-ergol propulsion devices ($N_2O_4, AZ 50$) developing a thrust of 500N;

- after the linkage with the station, makes possible the potential corrections necessary for maintaining the orbiting altitude of the station. This eliminates the need for taking to and stocking aboard the station the necessary propellants;

- finally, thanks to a powder engine of 40 KN, takes out of orbit the reentry vehicle containing the processed materials to be recovered (ΔV delivering 500 m/s, $\omega = 150^\circ$).

Furthermore, unrelated to a reentry vehicle, a simplified version of the propulsion module (elimination of the 40 KN engine) makes it possible to take to the station "processing plant" modules.

The reentry vehicle is a sphere 2 meters in diameter containing a cylinder-shaped 1 cubic meter container in which the materials to be transported are placed. The container can be reached through a round hatch containing the recovery parachutes.

At the launching the reentry vehicle is attached to the propulsion module and has on its front part a three point system for its linkage with the orbital station. The ablative materials which protect the reentry vehicle as it crosses the dense atmospheric strata are located on the opposite side.

Figure 4 shows the sequence for putting the shuttle craft into orbit: The shuttles are launched by Ariane (five per year according to the suggested hypothesis). They rendezvous with the orbital station for a soft docking because of the big nonrefoldable solar panels. The transfer of the materials from the reentry vehicle to the plant module and vice versa are accomplished by remote control.

Figure 5 gives the recovery scenario. Unhitched from the orbital station, the shuttle craft tilts in order to start the reentry procedure; thus it provides the decrease in velocity required for deorbiting. The separation between the propulsion module and the reentry vehicle takes place before the ballistic reentry. The reentry vehicle alone is recovered following a parachute landing.

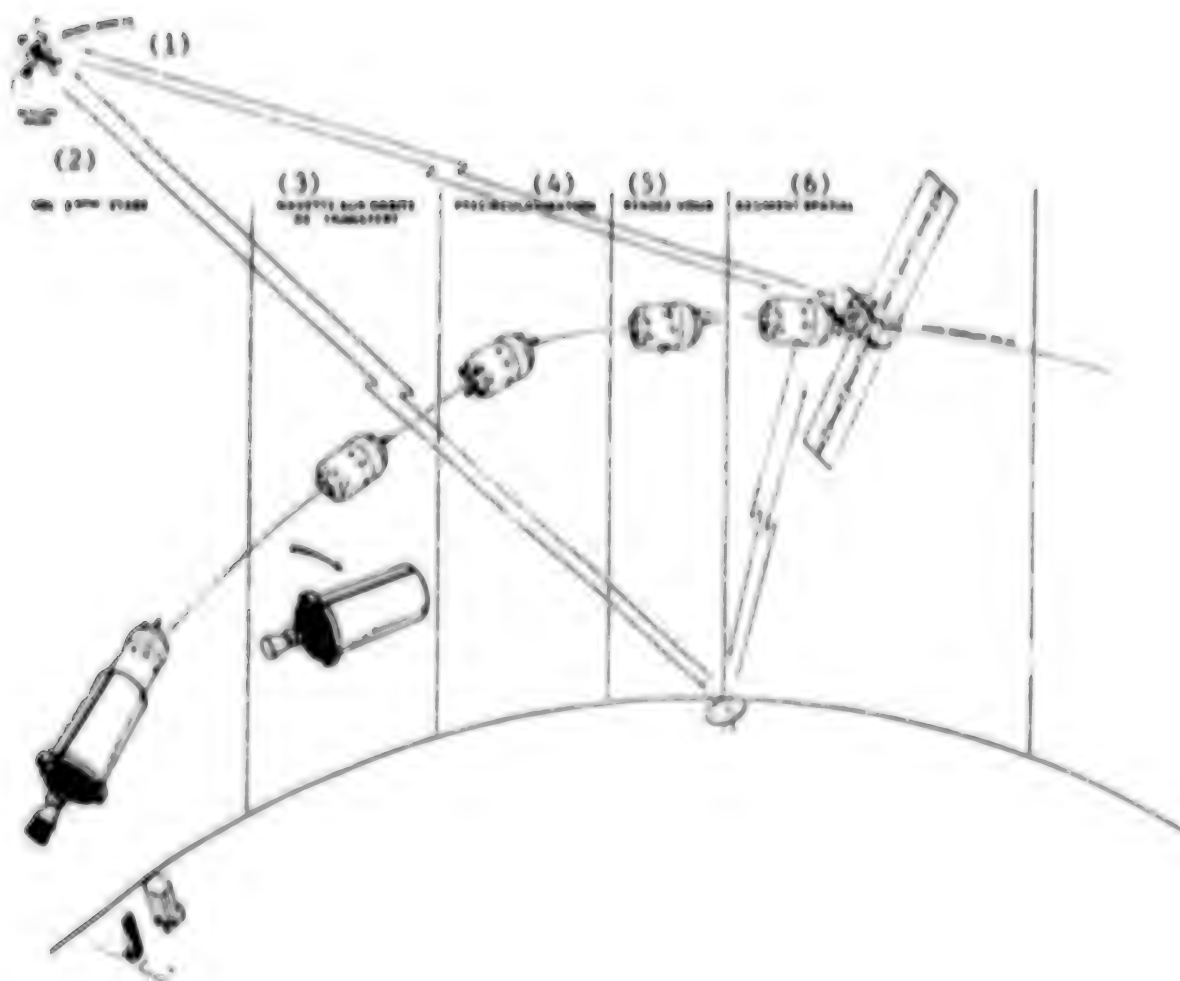


Figure 4. Placing the shuttle craft in orbit

Key:

- | | |
|-------------------------------------|--------------------------|
| (1) relay satellite | (4) preliminary circling |
| (2) third stage flight | (5) rendezvous |
| (3) shuttle craft in transfer orbit | (6) space segment |

The weight of the shuttle craft is 1,500 kilograms for the propulsion module and 760 kilograms for the reentry vehicle which, with Ariane III, leaves space for a payload of at least 2,000 kilograms.

Concept of a Multiple Mission Minos System

It seemed advantageous within the framework of this prospective study to consider a more futuristic Minos system consisting of a modular space complex which would allow both ground-observation operational missions and the simultaneous or nonsimultaneous production of several materials.

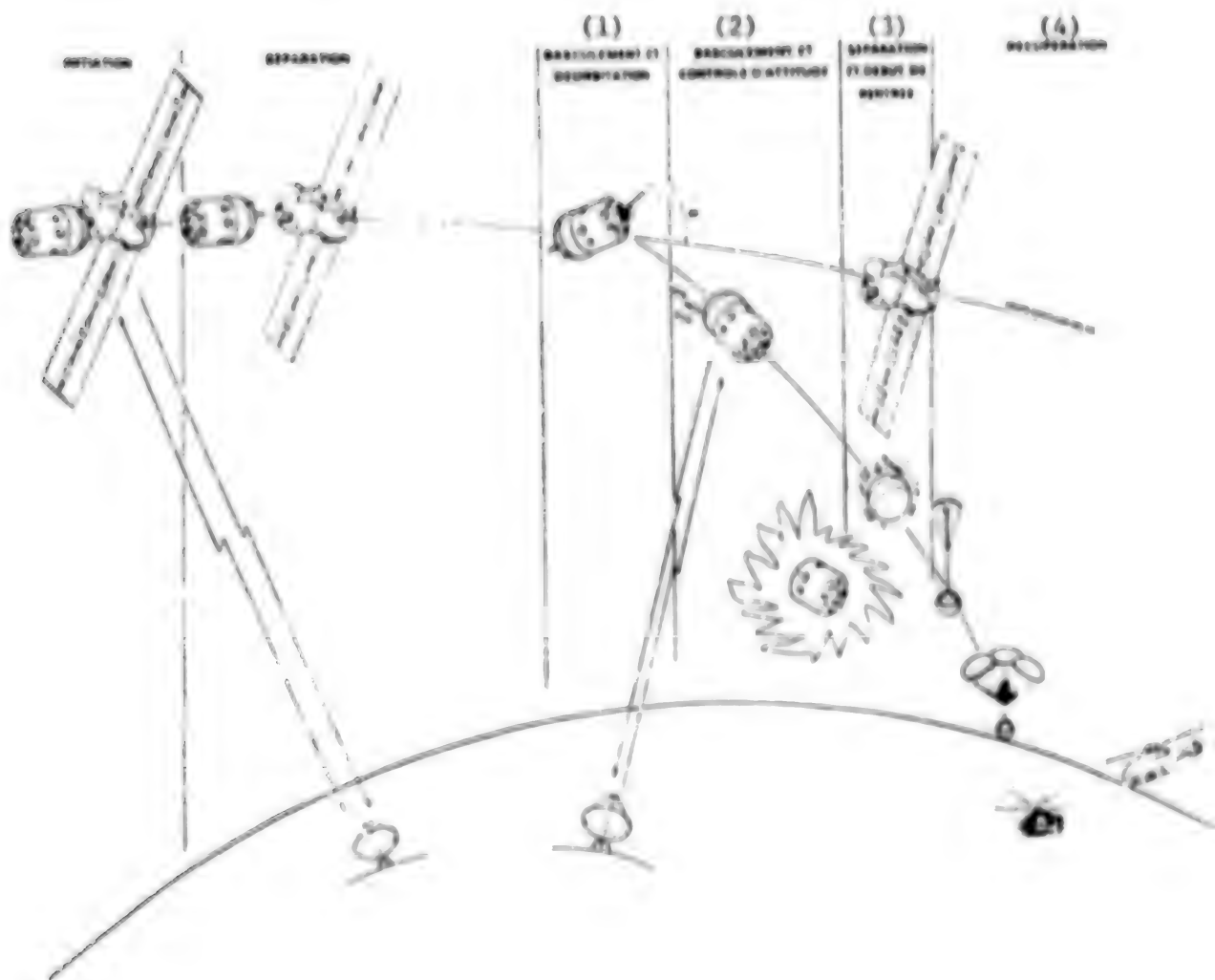


Figure 5. Reentry and recovery sequences

Key: (1) tilting and deorbiting (3) separation and beginning of reentry
(2) tilting and attitude control (4) recovery

Therefore, we are talking about a more developed and developing system (growth capability) which could be representative of the second generation Minos. This topic has been kept for the second phase of the work assigned to Matra.

As before some temporary choices have been made for the sake of limiting the study: heliosynchronous orbit, and an "intelligent" Apollo-type shuttle craft. Furthermore, the availability of a launching capacity corresponding to the Ariane V rocket has been assumed.

Definition of a Modular Concept (Figure 6)

The following principles have been adopted:

--The power-unit portion of the orbital station has been limited to a base module carrying unfolding solar panels. Therefore, it provides the energy and, furthermore, includes stabilization and telecommunications facilities;

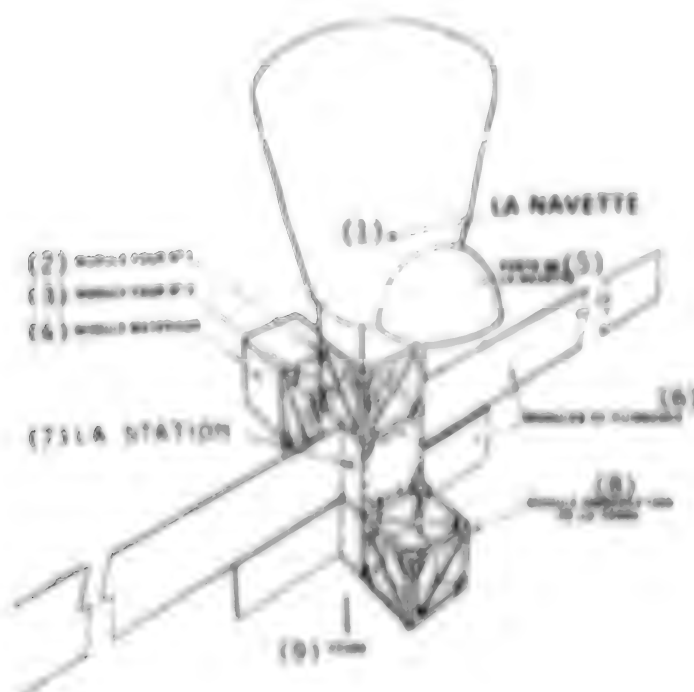


Figure 6: Multimission modular station (Natra concept)

Key:

- | | |
|-------------------------|------------------------------|
| (1) shuttle craft | (5) shuttle craft dock |
| (2) furnace module No 1 | (6) power modules |
| (3) furnace module No 2 | (7) the station |
| (4) materials module | (8) earth-observation module |
| | (9) earth |

--specialized standardized modules will be added to this central module as needed for the different missions to be carried out by the automatic station;

--because of their greater flexibility, these modules could be added to the base module and also to each other; furthermore, they could also be removed and returned to the ground;

--modules providing additional power with unfolding solar panels and additional stabilization modules, should the station be expanded, may be added to the orbital complex as standardized modules;

--the shuttle craft should be able to install or bring back several modules per flight (two appears optimal and has been adopted for subsequent computations);

--the principle of handling the modules is that the shuttle craft uses the modules in its hold as a docking interface;

--the shuttle craft could remain in orbit linked to the station or return immediately after recovering the modules to be replaced (such as, for example, the module containing the materials).

The Shuttle Craft

As in the previous model, the shuttle craft will be placed in transfer orbit with an Ariane rocket. However, in this draft project the craft will be an Apollo-type capsule of substantial size and entirely recoverable.

The lift of the vehicle will be low which will make it navigable: an aerodynamic efficiency of 0.3-0.5 seems adequate for piloting it in the atmosphere. It will be operated by influencing the average angle of incidence. The center of gravity of the shuttle craft will be eccentric in terms of the pressure center, thus creating a finite lift in a balanced position. By steadily affecting the roll a mean force is created which can be modulated perpendicularly to the trajectory. This provides a controlling facility in the atmospheric stage.

Figure 7 shows the shape of the shuttle craft with a hold containing two standard modules. The shuttle craft's propulsion system uses liquid propellants. In order to make the craft more versatile it could have remote control arms. Thus repair or maintenance operations could be carried out with this vehicle which could hook itself to different parts of the station thanks to a generalized docking system of the entire orbital complex.

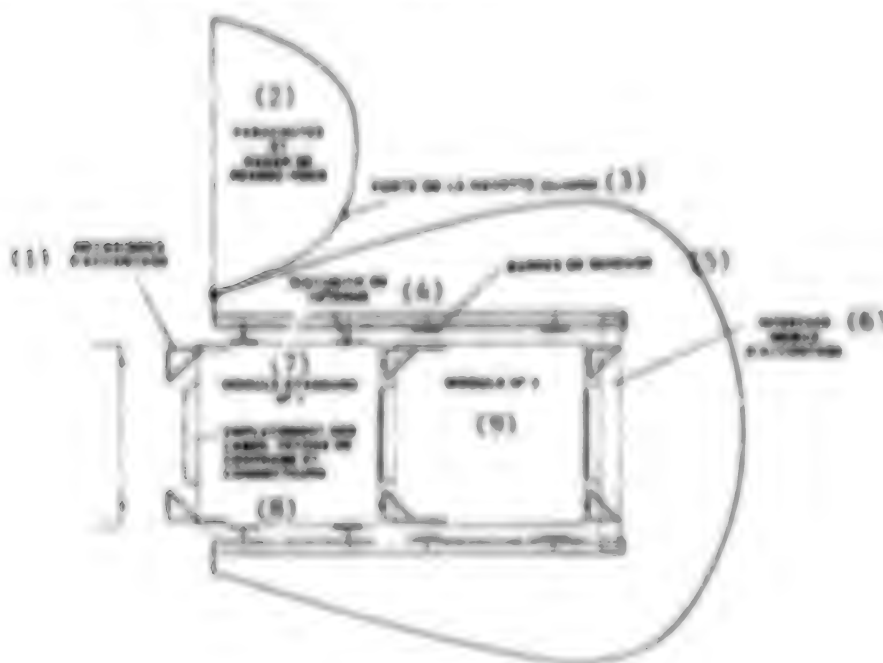


Figure 7. Shuttle craft (Natra modular concept)

Key:

- | | |
|-------------------------------------|---|
| (1) docking mechanism | (6) mobile docking interface |
| (2) parachutes and rendezvous radar | (7) standard module No 1 |
| (3) shuttle craft door (open) | (8) location of lasers, centering points and connectors |
| (4) retaining device | (9) module No 2 |
| (5) guide rods | |

Standard Module

The modules have a cubicle shape. A shockless docking mechanism with four points has been planned. Thus, each module has on one of its sides the active part of this mechanism while the passive section is located on the other five. This makes it possible to put together in three dimensions the cubes which form the space complex. The active face will include a laser to determine the distance and each passive face will have a reflector. This will standardize the modules and will make it possible, with the expansion of the orbital complex, to change the assembly positions of already placed modules.

Each module will be powered by the module of the station to which it is hitched. The functional electrical connections among the station cubes will be accomplished through a network of optical fibers.

Examples of Module Outfitting

The principle of the outfitting of the various specialized modules has been considered with a view to emphasizing the interface problems posed and the resulting limitations on the level of the definition of the standard module.

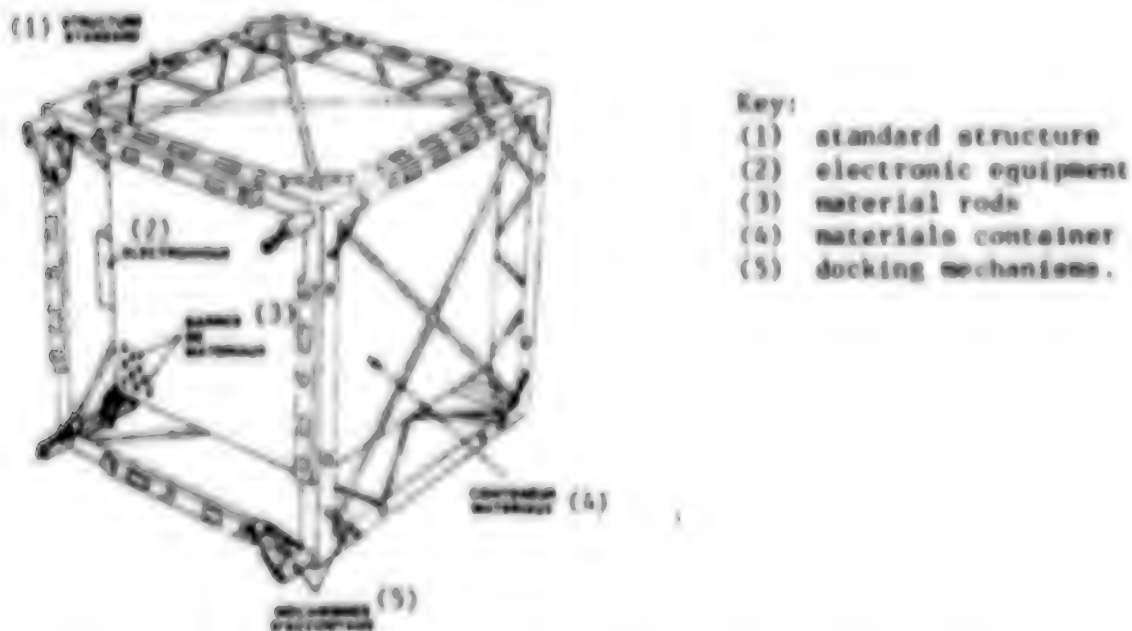
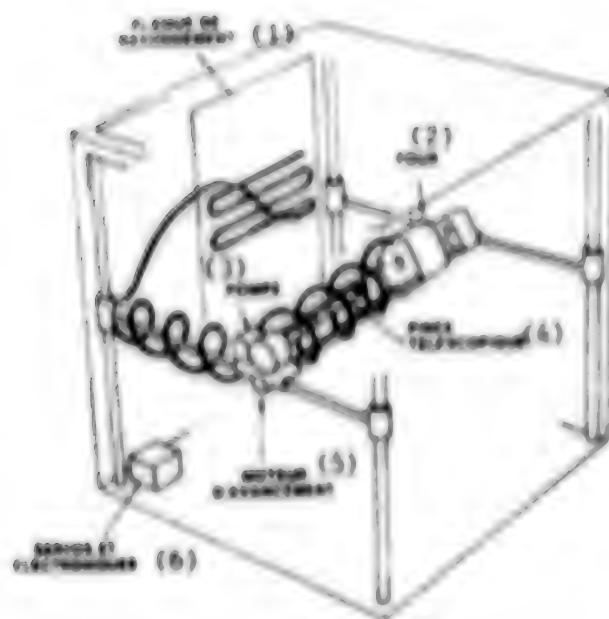


Figure 8. Standard module equipped with a container for materials

The artist's concepts (Figures 8 and 9) show the two basic modules for the "materials production" mission:

a) a "materials container" module (note on the sketch the standard external structure of the cube with its assembly mechanisms). The rods of materials to be processed are located in a matrix of fixed chambers. The processing furnace will have to move in order to face each raw material rod, pull it out and reposition it.



- Key:
- (1) radiation plate
 - (2) furnace
 - (3) pump
 - (4) retractable grip
 - (5) advancing motor
 - (6) servo and electronic mechanisms

Figure 9. "Processing furnace" module

b) a "processing furnace" module: It is characterized by a mobile central block which includes the furnace and the rod extraction and gripping mechanism; this block can move in X or Y directions to face a rod of the material in the container. The rod is gripped by a retractable mechanism and kept between two fixed points. Moving along the rod, the furnace fuses the necessary area for processing of materials in a gravity-free environment.

Possibilities Offered by the Minos System

The overall parameters of the mission theme considered in this prospective study, the production of materials in orbit, has been entirely confirmed.

The Minos system requires the development of new capacities for Europe in four different directions:

- a basic module stabilized and generating from 10 to 20 kilowatts representing the central nucleus of any automatic orbital station;
- a propulsion module added to the Ariane rockets allowing, after the placing in orbit, the transportation of payloads, rendezvous, and orbital corrections or changes;
- a reentry vehicle and related ground facilities insuring the automatic recovery of payloads, whether materials or films;
- a "space robotics" (systems and technology) which will eliminate the need for human presence in orbit in future industrial utilization of space.

The work done by Solan and Matre in the course of the Minos study has emphasized the most critical technologies. However, it has confirmed that the new developments to be achieved in these areas are within reach of European industry within a period of time compatible with the proposed missions.

Furthermore, the development of these new capacities and the improved versions of the Ariane rocket (types III to V) would give Europe access to large-scale practical astronautics at the end of the century using large automated stations assembled in orbit.

5157

(20) 5162

INDUSTRIAL TECHNOLOGY

DEMONSTRATION PLANT TO BE BUILT FOR INRED STEEL PROCESS

Stockholm NY TEKNIK in Swedish 14 Aug 80 p 4

[Report by Carl Daniel Norenberg]

[Text] Within a short time the INRED process will begin to be run continuously in a new demonstration plant in Lulea.

"This is a part of our continued effort at direct reduction of iron ore," says Torsten Jensfeldt, head of Boliden's development department.

The INRED method, development of which was begun by Boliden in 1972, has thus now reached the stage where testing in continuous operation will begin.

The new plant will function partly as an experimental plant for ferroalloys of various kinds for nearly a year. It will also, as an experimental plant, be made available to prospective license-buyers.

"The first plant will presumably be sent abroad," says Hans Elvander, in charge of technical projects at Boliden.

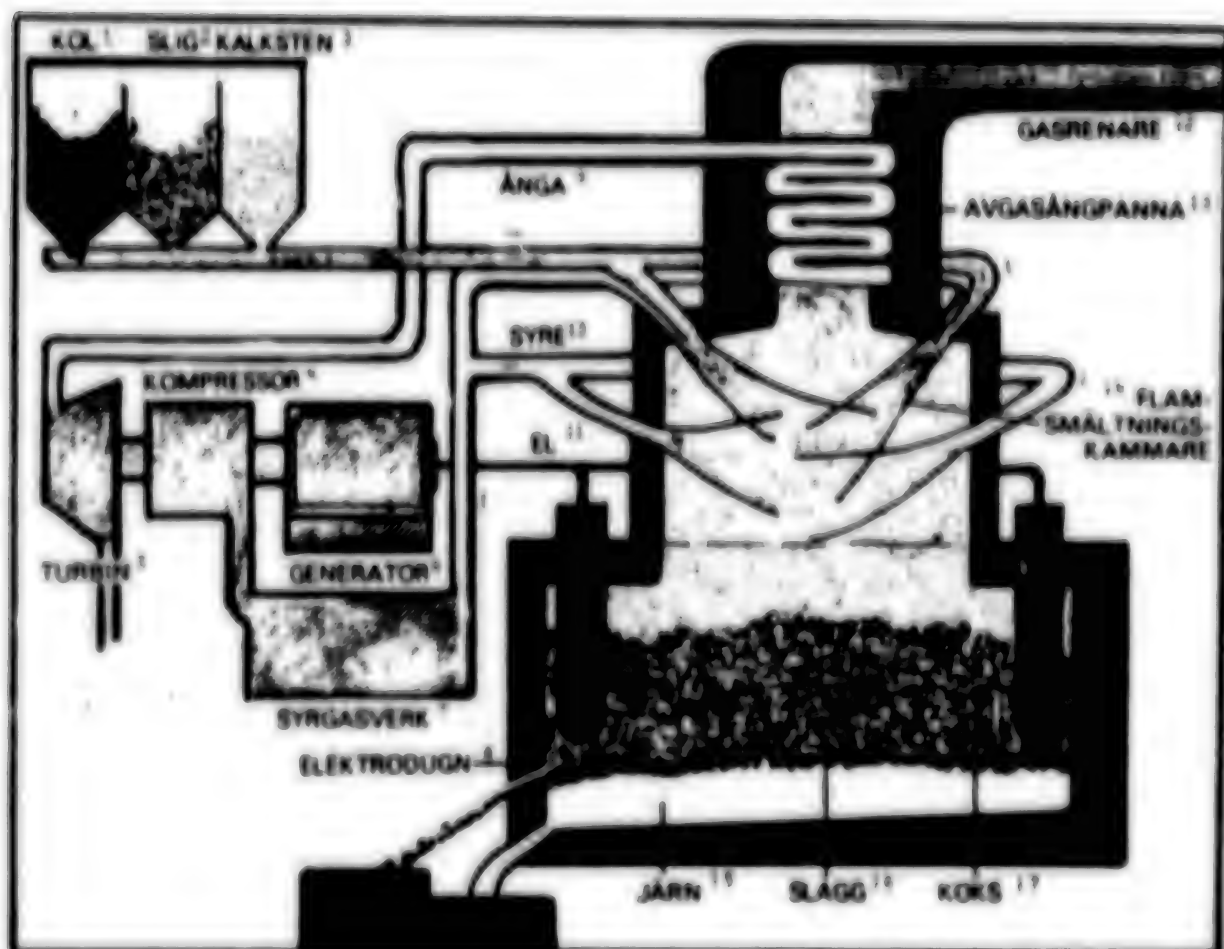
"This plant can be regarded first and foremost as an enlargement of and addition to the old experimental plant," Hans Elvander continues. "Among other things an electric furnace will be added which gives the plant a capacity of 8 tons of pig iron an hour. Since INRED is a computer-controlled process, thus far very small amounts and brief experiments have sufficed for study of the processes and equilibria involved. During that time experiments were done with various alternative applications as well, for the INRED method is not limited to the pig-iron process.

"We have had very good results up to now," Hans Elvander continues, "and now we shall also have a chance to run the INRED process continuously."

Facts About INRED [See the figure on the next page.]

The INRED process works in two stages. Both stages take place in the furnace.

The slag [see note], powdered coal, and acid gas are blasted, together with limestone, into the upper part of the furnace through special nozzles, which produces



Drawing by CARL GÄRNER, HÖRNINGEN

The INRED process has been developed by Boliden AB (AB = Inc.). It is a "direct reduction" process for production of pig iron. The process is explained in the text.

- 1 Coal
- 2 Slag [see note]
- 3 Limestone
- 4 Compressor
- 5 Turbine
- 6 Generator

- 7 Acid gas absorber
- 8 Electric furnace
- 9 Steam
- 10 Acid
- 11 Electricity
- 12 Scrubber

- 13 Exhaust gas boiler
- 14 Flame smelting chamber
- 15 Iron
- 16 Slag
- 17 Coke

a whirlpool motion in the "flame smelting chamber." There the mixture of hot gases coming up from below is ignited. The slag melts and gives off acid to the powdered coal, and begins to settle slowly to the bottom part of the furnace. Part of the powdered coal is burned and part forms coke.

In the electrically heated lower part of the furnace the remaining acid in the slag combines with the coal, while the lime absorbs other impurities and forms slag. The now free iron collects on the bottom of the furnace and can be drawn off as in an ordinary blast furnace.

The heat from the process is utilized in what is called the exhaust gas boiler. That boiler drives a turbine, which in turn is used both to operate the acid gas apparatus and to generate electricity for the electric furnace.

Notes:

Slig is the name given to the fine-grained ore concentrate that is obtained by crushing, grinding, and concentrating.

Coke. In the coking process the coal undergoes a gradual rise in temperature, under which the volatile substances found in the coal are driven off in the form of "crude gas." The coal left behind sinters together into a more or less cohesive cake.

RR15

CSO: 3102

FORMING SHEET METAL BY EXPLOSION DESCRIBED

Paris L'USINE NOUVELLE in French 18 Sep 80 pp 160-161

[Article by Patrick Piernas: "Sheet-Metal Shaping--Explosives Replace Punch"]

[Text] A blast from a siren, several seconds of silence, followed by a dull explosion accompanied by a shower of water. Within 1/10,000 second, an inoxidable piece of steel plate with a diameter of 4 m and a thickness of 4 mm has taken on a spherical shape due to the action of several hundred grams of explosives. This not at all customary operation is being repeated several times a day in the explosive firing trench under the auspices of SECATHEN (Society for the Study and Application of High-Energy Shaping Techniques) established out in the middle of nowhere (with good reason!) in the eastern part of France, a few kilometers from Serre-Union.

This small subcontracting enterprise consists of 42 persons specializing in explosion-shaping and in welding and boiler work; its business volume increased from F 1 million in 1973 to F 4.2 million in 1979 and it is expecting to reach F 7.7 million in 1980. "An evolution which bears witness to the development of applications by explosion-shaping in industry, primarily for making elements of fixed or mobile tank storage vats but also heat exchangers equipped with plates," explains Pierre Monneret, technical manager. Vat bottoms [foundations] shaped by explosion are used in the food industry (beer breweries and wine-making) and in chemistry. SECATHEN has gotten some nice references from Alfa-Laval, BSL, Guerin, Ziemann-Hempel, etc.

Method's Advantage: Preserving a Constant Thickness

These vat bottoms [foundations] can be obtained in very fine thicknesses (minimum 1/1,000 of the diameter; maximum 7 mm). Explosion-shaping presents the advantage of maintaining a constant thickness during shaping, particularly in the square, which is the most heavily-stressed part. "It is thus not necessary to start with a thicker steel plate, as is the case with stamping or punching, which in turn facilitates very substantial raw material savings, especially when we use inoxidable steels," Pierre Monneret emphasized. Besides, the surface state is not altered and above

all there is no cold-hardening [cold-hammering] (something which generates corrosion). Metal deformation is obtained through the explosion of a detonating cord which is judiciously placed inside the welded blank (flat sheets assembled in the shape of a corolla). The detonation of the explosive creates a shock wave which is transmitted to an incompressible liquid (water) which presses the sheet against the matrix. SECATHEN has a large number of tools for the various dimensions used in making foundations for vats with low pressure and foundations for vats that must resist chemical corrosion.

In certain cases, they even dispense with the use of tools. That happens in the case of the manufacture of spheres. The operation is quite spectacular: the operator places an explosive charge at the center of a welded blank (several flat sheets welded together to form a kind of Venetian lantern). After several successive shots, the piece obtained is perfectly spherical and has the same thickness as the starting sheet. This process proves to be very economical in making small series of spherical bottoms, especially those which require "mixed" dimensions (with diameters between 160 and 3,600 mm and soon 7,000 mm). Here are some applications: production of the foundations [bottoms] of tank trucks for the transport of pulverulent substances and the doubling of tank bottoms under pressure in a corrosive environment. In the chemical industry, we as a matter of fact frequently connect a bottom, made of inoxidable metal, to the inside of a bottom made of ordinary steel. In this case, explosion-shaping enables us, according to certain measurements, to make a bottom of inoxidable steel with the exact diameter of the shape in regular steel.

In addition to tank elements, explosion-shaping is used in making elements for heat exchangers. Thanks to the use of adjustable tools made of steel with intermediate layers of wood, SECATHEN is making elements of corrugated sheet metal to measure, both regarding the general dimensions and the cross-section of the duct and the fluid circulation diagram. These elements are welded upon sheets which are then assembled to form tanks with heat-exchange walls. Here are the main applications: fermentation vats in beer breweries, made among other things for the Ziemann-Hengel Company which owns 90 percent of the shares of SECATHEN. Along with this conventional application of shaping, SECATHEN has just found new uses in making compact heat exchangers with welded plates for use in the petroleum industry, in the geothermal and nuclear industries. For this purpose it created a subsidiary company, called ATHEN, in which the NAT Company, a subsidiary of Elf-Aquitaine and the French Petroleum Institute, took out a share of 35 percent.

Each Exchanger Is Tailor-Made

The exchanger produced here uses a stack of double-stamped plates shaped by explosion. It can guarantee a gas-gas or liquid-gas exchange at temperatures

of as much as 600 °C, with a high inside pressure (9 bars at 530 °C). "This type of exchanger works at higher pressures than an exchanger with jointed plates; it offers a yield that is between 10 and 15 percent higher than the one of a tubular exchanger but above all it proves to be more compact," says Pierre Monneret. The first exchanger with a surface of 25 m² is in service on a test loop at a gas deposit at Lacq and the second model, with 1,300 m², was installed in Indonesia on a petroleum platform (gas burnoff).

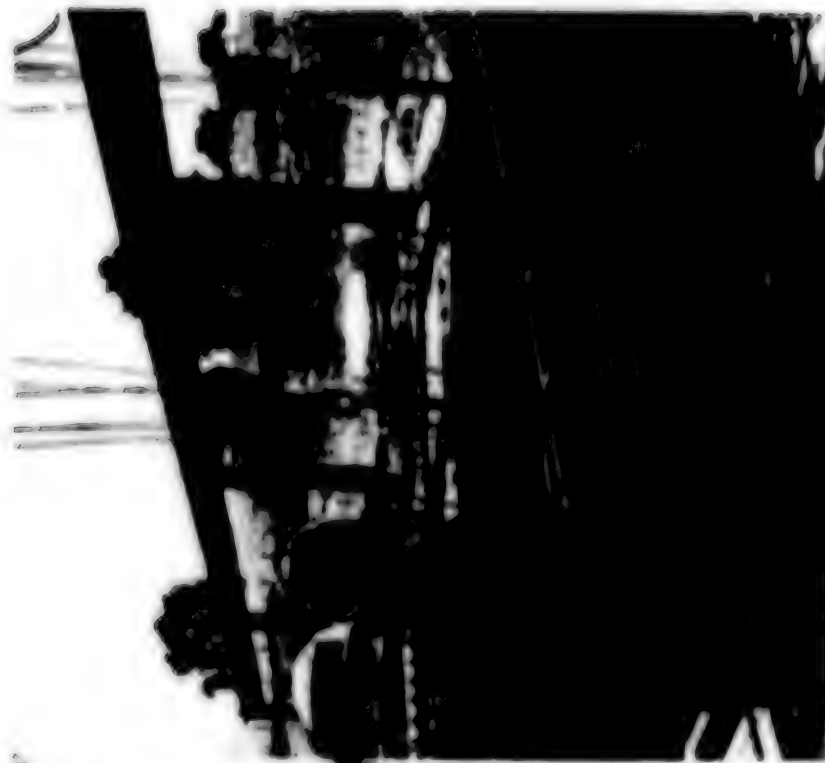
Assuming an equal exchange surface, this equipment, which is 5 m long and has a diameter of 2.5 m, proved to be between three and four times less voluminous than a tubular exchanger and weighs 27 t, as against 70 t for an equivalent tubular exchanger. Each exchanger is tailor-made; the research bureau determines the ideal profile for the plates as a function of the fluid to be run through and then goes into series production for the plates (about 500 pieces).

SECATHEN is currently studying a gas-water exchanger of 300 m² and is planning to make a gas-gas exchanger with 3,000 m². That may be little when compared to some of its "exploits": especially the construction, for a NASA supplier, for a quarter torus consisting of Hastelloy with permitted elongation in the weldings amounting to less than 2 percent and the production of space environment simulators capable of tolerating abrupt temperature changes from -178 °C to +178 °C. Here we must not forget some artistic projects (3 percent of the business volume), such as the sculpture "Le Signal" which stands in the courtyard of the ENA [National School of Administration], the sandbox of the ZAC at Saint-Martin-d'Heres and the Lyre of Vandoeuvre, near Nancy, which were made by explosion.

The industrial objectives of SECATHEN currently are aimed at extending explosion shaping to the preseries production of parts for auto bodies and the shaping of copper electrodes for electro-erosion. In this latter application, it will suffice to have one model to get copper electrodes with an excellent surface state not requiring any polishing or retouching.

Summary:

Vat bottoms, tank elements, exchanger plates are now made economically and in special dimensions due to explosion-shaping by a small subcontractor called SECATHEN. Other applications are in progress, such as manufacture of compact exchangers, preseries production of car body components and shaping of copper electrodes for electro-erosion.



Production of a heat exchanger plate made of inoxidable steel (thickness 12/10 mm x 4.5 m x 1.15 m). 1. Placement of detonating cord; 2. Immersion of plate; 3. Plate is finished. Note the undulations obtained in a single operation.



1. The welded blank, consisting of sheets welded together in the form of a corolla, is moved to the firing trench.



2. The welded blank, placed in the matrix, is lowered to the bottom of the trench. In its upper portion, we note the detonating cord placed in net sheet.



3. The blast causes a burst of water. The explosion has lasted 1/10,000 second.



4. The vat bottom, completely finished, after polishing.

INDUSTRIAL TECHNOLOGY

AUTOMATED RIVETING FOR AIRBUS ASSEMBLY

Essen ELEKTRO-ANZEIGER in German Jul (2) 80 pp 12-14

[Text] Approximately 50 percent of the manufacturing costs of an aircraft frame go to the jointing of components. A further breakdown of the percentage shows that 90 percent of these costs are caused by rivet setting alone. The balance is rivet procurement costs. The importance of an economical application of the riveting procedure in aircraft frame construction may be derived from the fact that an A300 airbus features more than 1 million riveted joints in spite of a high percentage of glued joints.

The high manufacturing costs of an aircraft frame caused by riveted joints--which are even higher if double-planked assemblies are involved, e.g., controls, wings, flaps, due to the fact that they are less accessible--can be reduced by completely new and efficient production procedures only. This will be necessary particularly in view of the acceleration of the Airbus program. A reduction of the costs of riveted joints can be achieved by combining various work steps like boring, lowering, or riveting in an automated riveting system developed for this purpose.

Inserting the components in a standardized frame will enable the transfer of workpieces through the various assembly stations connected with each other. The entire process, i.e. component positioning, clamping, boring, lowering, rivet setting and hammering will be automated by means of a numerically controlled positioning equipment.

State of Development

At present VFW is actively developing a numerically controlled flexible assembly line of this kind with the help of the Ministry for Research and Technology. It is to rationalize the accelerated A300 Airbus and A310 Airbus production which is starting now. The components to be manufactured by VFW as part of these programs include double-planked structures which require a high degree of technology. These components, e.g. passenger doors, cargo gates, cargo room floors, flaps, and spoilers will still

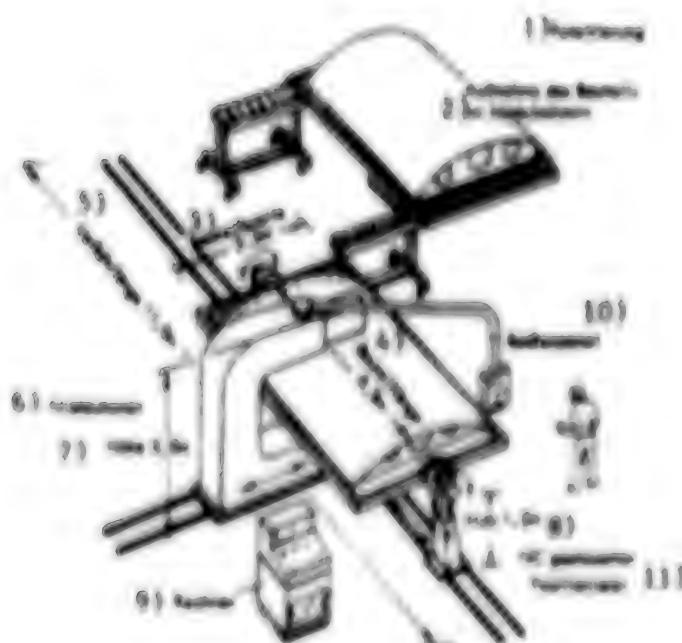


Diagram of Flexible Riveting System

Key:

- | | |
|---|---------------------------------------|
| 1. Palleting | 6. Automated riveting equipment |
| 2. Clamping component into module frame | 7. Height: 3.0 m |
| 3. Component width: 3.2 m | 8. Lift: 1.2 m |
| 4. Component length: 8.5 m | 9. Computer |
| 5. Traversing distance: 11.0 m | 10. Operating panel |
| | 11. Numerically controlled positioner |

The figure illustrates the VPA automated riveting and assembly system. Center of the system is a riveting automaton integrated into the flexible palleting and positioning system for major components. The process chain includes the clamping into the module frame, automaton feed, and the joining procedure. The palleting enables a continuous work process.

feature a high percentage of riveted joints in spite of an extended use of gluing and composite fiber construction.

Due to the spherical deformation of these components, rivet hole boring and rivets require five-axial feed and positioning movements. As the automated riveting system does not move on its own, the positioner must have adequate freedom of movement so that the components will always be in a vertical position at the riveting point.

Work Steps

In the VFW flexible assembly line the components to be manufactured are clamped into a so-called module frame, transported within it, and fed into the individual work groups. The module frames constitute the integrating part of the entire control system, which is comparable to a palleting system as used with machine tools.

The process being developed will result in a cheaper manufacture, particularly of the spherically formed parts, a reduction of assembly steps, of the time the devices are occupied, and thus an increase in productivity.

The quality of the new assembly system becomes particularly apparent at the automated riveting part of the system with positioner. While one to a maximum of one and one-half rivets per minute can be hammered manually, the automated riveting equipment of the flexible system will complete 13 rivets in the same period. In addition, the numerical control will guarantee high-accuracy reproducibility.

Reduction of assembly costs, reduction of manufacturing devices and space requirements, as well as a more human working environment (avoiding monotonous work and lowering of noise levels) are the essential advantages of this assembly system.

9544

Doc: 3102

NEW PROCESS INCREASES CREEP STRENGTH OF ALLOYS

Stockholm NY TEKNIK in Swedish 14 Aug 80 p 18

[Report by Carl Daniel Norenberg and Gunnar Söderström]

[Text] Powder metallurgy is the materials technique of the future. But Sweden is losing its lead. For that reason more money must be put into basic research. An example of such basic research is Mats Dahlén's recently published paper on the creep strength of "super alloys."

A super alloy contains many different metal components which contribute to improving the properties of the finished alloy. Characteristic properties are high elastic limit, high fatigue strength, good creep strength, and good corrosion properties at high temperatures. Mats Dahlén has shown that by a special thermo-mechanical process it is possible to get an enormous increase in the creep strength. This is very important, since creep is one of the factors that, for example, determine the efficiency of a jet motor. Creep means that the material is slowly elongated under stress. The phenomenon is especially important at high temperatures, such as occur in a jet motor or gas turbine.

Nickel-Base Alloy

Super alloys can be classified in three groups depending on whether the chief component is nickel, cobalt, or iron. The most important in high-temperature metallurgy are the nickel-base alloys. Nickel as the basic element gives a structure-stable alloy. The most important alloy elements after nickel are titanium and aluminum, which give high temperability. Among other alloy elements may be noted chromium, which together with aluminum gives good corrosion resistance.

The super alloys are normally produced by casting and final forging. Now such hard materials are beginning to be produced that they can hardly be worked. By modern powder metallurgy techniques, however, the problem can be overcome.

The new method is based on first obtaining a powder by, e.g., atomizing a falling stream of molten metal with a protective gas. By great chilling the particles at the same time acquire a very fine structure. This gives the material good formability before heat treatment, with possibilities of what is called superplastic deformation (extensibility of more than 1,000 percent). The material is then confined in a mold, where it is compacted by, for example, hot isostatic

pressing. Then the part is forged to very near the finished shape. The method has very great economic advantages, Mats Dahlén says. There are savings both in expensive material and in treatment costs.

"The technique also makes it possible to manufacture parts from materials that are very nearly impossible to work at reasonable cost."

Grain Growth

The forged parts as a rule have a very fine-grained structure. This entails poor creep strength at high temperatures. Mats Dahlén has developed a thermomechanical method of increasing the grain size to the optimal value. By thermomechanical treatment is meant a combination of deformation and heat treatment that gives properties that cannot be obtained by simple heat treatment. Dahlén's method is based on deformation followed by heat treatment in a steep temperature gradient. Experiments have resulted in grains that are limited only by the dimensions of the specimens. These large grains give extremely good creep strength properties.

Development in powder metallurgy has reached a stage today where powder material is used in military planes, and civil aviation will presumably not be far behind.

BA/S

CSU: 3102

SCIENCE POLICY

GOVERNMENT FUNDING FIGURES FOR R&D REVIEWED

Frankfurt/Main. FRANKFURTER ALLGEMEINE BLICK DURCH DIE WIRTSCHAFT in German
11 Sep 80 p 7

[Article by TH: "Only a Few Companies Receive Research Funds"]

[Text] Frankfurt, 10 Sep--On the basis of documents published by the Federal Government after inquiries in Parliament and on the basis of individual presentations by ministries it is possible to determine which companies in 1979 received how much in state research funds from the Federal Government. According to information by the Research Ministry, a total of about DM 2.2 billion were made available in 1979 for support of research projects by the Federal Government. DM 2.1 billion of these were allocated to the Research Ministry. Beyond that, there was also indirect research support in the amount of DM 474 million. This included for example the personnel allowance for research and development, which is handled through the Federal Ministry for Economic, and various measures aimed at supporting research as a whole in the economy.

In the Research Ministry publications the companies are listed according to name. The Research Ministry does not rank the firms by business in groups of companies, so as a purely percentual representation of the distribution according to alphabetically arranged firms indicates very little. For example, for the Siemens group in the table above the 100-percent subsidiaries, which are among the largest recipients, were also combined in order to get an overview of the total sums which go to the Siemens group. Even so, this is only an estimate, since the Research Ministry named only the 30 largest allocation recipients with the amounts paid to them in the Bundestag publication.

Many small subsidiaries of the cited companies are not included here. It must also be assumed that the above indicated amounts for individual companies constituted only the lower limit of the amount of research allocations through the Research Ministry. What applies to Siemens also applies to AEG. For the latter only the parent company is shown, but many subsidiaries are not. For the large technical projects it is very difficult to rank them according to company. This is why they are shown separately.

The above compilation shows that 24 companies, which received research funds from the Research Ministry in 1979, got 63 percent of the research money. Moreover, the concentration at the top is very great. Six companies or groups of companies received 47.5 percent of the government research funds of the Research Ministry.

The following table shows the research support in 1979 of the Research Ministry listed by company:

Research Support of the Research Ministry in 1979

| Total economic support | Group | in million DM 1979 |
|--|-------|--------------------|
| 1. MAN (Maschinenbau- und Bergbau-Union) | | 151.9 |
| 2. Siemens | | 201.9 |
| 2.1 Siemens | 17.9 | |
| 2.2 KWT (Kraftwerkunion) | 28.1 | |
| 2.3 Interatom | 60.4 | |
| 2.4 LNT | 13.5 | |
| 3. Ruhr Coal | | 112.7 |
| 4. Breeder reactor development | | 158.3 |
| 4.1 Jüß | 103.3 | |
| 4.2 SSK (Fast Breeder Nuclear Power Plants Inc. (Essen)) | 55.0 | |
| 5. High temperature reactor | | 152.1 |
| 5.1 THTR Kss. (Thorium High-Temperature Reactor) | 115.2 | |
| 5.2 HTR (High-temperature Reactor Construction Inc (Mannheim)) | 22.9 | |
| 5.3 HTR (High-Temperature Reactor Construction Inc (Schwabenhausen)) | 14.0 | |
| 6. Uranit | | 98.2 |
| 7. Uranior | | 52.9 |
| 8. AEC (General Electric Co.) | | 38.6 |
| 9. GAN (Augusta-Sueterberg Machine Works Inc.) | | 26.9 |
| 10. Niedorf | | 24.1 |
| 11. Rheinbraun | | 22.7 |
| 12. KWT (Rhin-Westphalia Electric Power Corps.) nuclear power plant-Bavarian Works | | 23.5 |
| 13. Mining Research | | 20.0 |
| 14. GRS (Society for Reactor Safety Inc) (Cologne) | | 19.2 |
| 15. ALFEM | | 17.7 |
| 16. Kempte | | 16.9 |
| 17. Nukem | | 16.9 |
| 18. Homburg Works | | 15.3 |
| 19. IABG | | 14.7 |
| 20. Saarberg Works | | 14.7 |
| 21. Polier Steel | | 14.5 |
| 22. Frupp | | 14.1 |
| 23. Gaisler Bona | | 13.9 |
| 24. HIL (German Iron and Steel) | | 13.7 |

Source: Bundestag publication 8/4457, page 4

Considering this heavy concentration the question must be asked whether the quite considerable administrative expense of the Research Ministry is still in reasonable proportion to the supported projects. If the groups of companies mentioned are excluded, DM 1.17 billion in research funds were available for all other enterprises. Project support to the economy constitutes about 75 percent of all research projects supported by the Research Ministry. For this, at least 1,100 persons are employed in the administration of research. In view of the heavy concentration of research support for a small group of firms or projects, respectively, this appears even less meaningful than is expressed in all overall view.

However, in addition to the Research Ministry there are also a number of other ministries, which support enterprises in their research. In the civilian area this is mainly the Ministry of Economics. Furthermore, however, there are considerable contracts from the area of defense. For this the Research Ministry for the first time has provided some data which are summarized and shown in the following table.

National Research Support by the Federal Government in 1979

| Ministry | Fed. Ministry for Research and Technology | Fed. Ministry for Defense | others | total |
|------------------------|---|------------------------------|--------|--------|
| 1. MBB Munich | 151.9 | 104.5 | 12.1 | 268.5 |
| 2. Siemens | 99.9 | 62.6 | 0.1 | 162.6 |
| --with subsidiaries | 201.9 | 62.6 | 0.1 | 264.6 |
| 3. Dornier | 52.9 | 87.9 | 2.5 | 143.3 |
| 4. AEG | 38.6 | 145.5 | 0.3 | 184.4 |
| 5. Ruhr Coal | 112.7 | - | 50.1 | 162.8 |
| Total: | 558.0 | 400.5 | 65.1 | 1023.6 |

Source: Bundestag publication B/4457, page 4

The Research Ministry is dominant in civilian support of specific projects, if the indirect promotion of research is left out, since the ministry distributes 90 percent of the research funds. If the civilian research support and military research support for 1979 are combined, the total is an amount of about DM 1.1 billion, of which DM 7.2 billion are for civilian research support. The above figures result in the following conclusions: In 1979 the company groups of MBB, Siemens, Dornier, AEG and Ruhr Coal received at least DM 1.02 billion in research funds from the Federal Government. The share of the above-mentioned companies of the total research support of the Federal Government is 33 percent. The principal recipient is the firm of Messerschmidt-Bölkow-Blom (MBB), Munich, which got at least DM 268.5 million, followed by Siemens with its 100-percent subsidiaries and an amount of DM 264.6 million.

In view of the fact that a number of subsidiaries with smaller amounts were not included, the above-mentioned figures represent only the lower limit, so that they may be regarded as unreliable. How these facts are to be evaluated individually is another question. However, the disclosure of these relationships

is important, in order that the governmental research supports may be subjected to careful scrutiny in its entirety. In connection with the above figures it must be observed that the indirect research support is now benefiting the small- and medium-sized companies, chiefly through personnel allowances and tax relief, rather than the largest enterprises.

The government's research support is concentrated to some companies or groups of companies through the establishment of research priorities by panels of officials. Although the government's share of the research expenditures in the economy was a maximum of 20 percent even in 1979, the present condition leads to a strong influence over the direction of research, because the government's share is already very large in some individual branches of industry.

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TRANSPORTATION

AIRBUS INDUSTRIE: STATUS, FUTURE PLANS

Rome AVIAZIONE in Italian Sep 80 pp 522-526

[Excerpts] The Present Situation

The A300 (Figure 14), in its different versions, is presently in service in or on order by 34 companies worldwide, with firm orders and options totaling 409. Alitalia's first aircraft, Tiziano, bears the serial number 101. In the A2 configuration, the A300 is fitted with 18 first-class seats and 235 tourist-class. Up to 10 tons of goods can be transported in its holds, in addition to the passenger baggage. This carrying capacity has already produced advantageous economic results. The figure illustrates the experience of several operators who use the aircraft exclusively for passenger routes, mostly short-range. This involves a freight traffic which for the most part did not previously exist and which is therefore due to the possibility of transporting on the A300 products that would have reached their destination by surface vehicles and probably loaded, in large part, onto medium to long-range wide-body aircraft. Taking account of the fact that a ton of goods is "worth" about 6.5 passengers, one notes that Air Inter, for example, transports an average of 32 invisible passengers per flight, in addition to the approximately 300 that it can actually put on board. It is obvious that this earning capacity, at marginal cost, is particularly welcome to all operators who, if they have aircraft of the DC-10 and Boeing 747 type in their fleets, can increase their carriage of freight without having to use the short to medium-range freight aircraft, which are expensive to run. Thus, what was planned at the design stage when the main fuselage section was defined has been verified in practice.

Development of the A310

Even before the A300 flew, a requirement for an aircraft with around 200 seats, with the possibility of operating over longer runs from shorter runways than those possible for the B.2 and B.4 basic versions, was being outlined. British Airways in particular had a requirement for a machine of this type as early as 1972, and this got the A300-B.10 project, with RR (Rolls Royce) RB. 211 engine, started. The initial stipulation was for an airframe as close to the normal A300 as possible, and the B.10 turned out to be a B.2 with shortened fuselage and with the same wing, but with a simpli-

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A300/A310 production programme

Partners' investment to increase production rate

1979 financing investment plan (M 100 million)

A300/A310 investment FF 120 million

Costs to build facilities 8 21 million

Deliveries: 1979-82 1 20-25 million,
plus 1 20 million on backlog to produce 20 million
sales per year

Two additional ... to be built

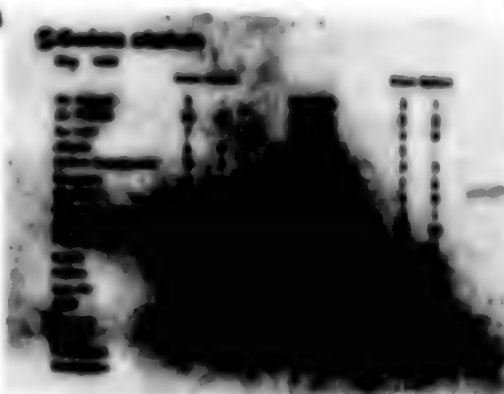
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A300 overall relationships

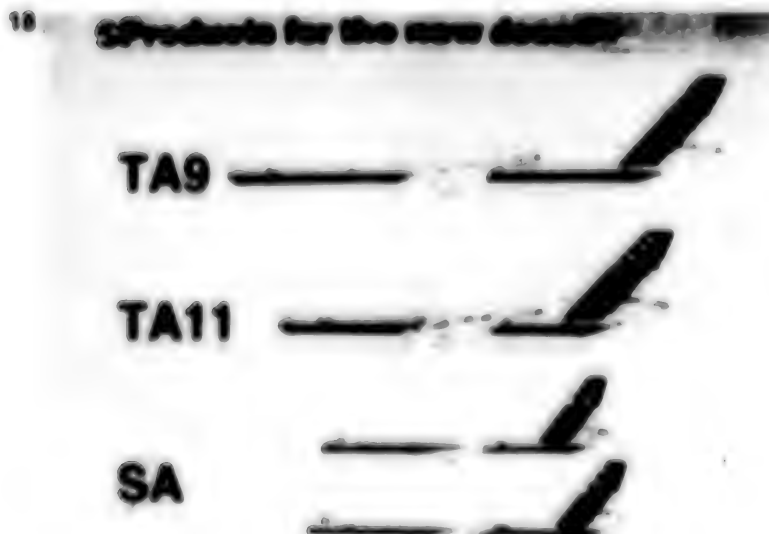
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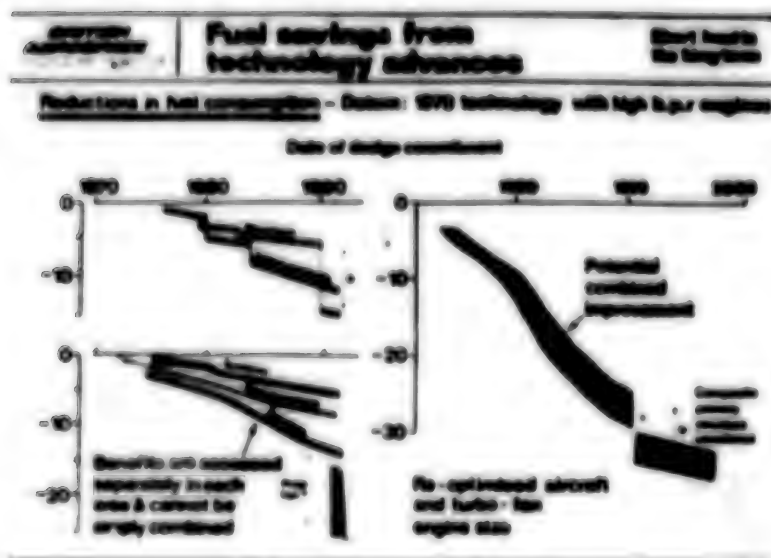
find flap system. Moreover, it was noted during development that use of the technological and aerodynamic developments of the decade since the startup of the A300 project would make it possible to improve the machine's efficiency further, giving the operating companies extremely attractive levels of operating economy. The Airbus group only needed to follow this line, trying to maintain the highest degree of commonality between the new aircraft and the A100 that would be compatible with a machine that was generally advanced vis-a-vis the present state of aeronautical technology. Lufthansa in particular required the lightest airplane possible, for use on short runs, while Swissair—which had not purchased the A300—required a machine with longer range. It was therefore decided to adopt a new wing, development of which was initially assigned to the French and German engineers and then went to the English upon Great Britain's reentry into the consortium, on the analogy of the wing for the original A300. The work, based on the use of highly advanced wing profiles, led to a wing that probably represents the maximum possible efficiency with the present technologies. By maintaining a 18° sweep and using thick profiles (15.2 percent at the root, 10.8 percent at the tip), a wing was obtained with aspect ratio of 8.8, which, even though it is equipped with a simplified flap system by comparison with the preceding model, reaches a max C_L [Lift Coefficient] of about 3.0.

It is worthwhile to point out that the wing of the A300 has not had to be sized—as often happens—with a view to enlarged versions of the machine; it



therefore works out as the most economical in function of the anticipated use of the aircraft. The aerodynamic development of the airframe has also been directed toward reduction of parasitic resistance and of interference between wing and engine pods. For this last-mentioned work, wind-tunnel models were used that reproduce the functioning of the engine in such a way as to simulate the effective aerodynamic field with maximum approximation.

The A310 will be based on the fuselage of the A300, thus retaining its characteristics of comfort and of transport of standard containers in the lower holds--but with many changes (Figure 16) designed to optimize the machine in such a way as to be able to compete effectively with the new Boeing 767 and

[illegible]

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Area of technology advance



Configuration control and operation of the on-board systems has been entrusted, though, to luminous electromechanical indicators arranged in a central panel on the ceiling of the cabin. In addition, about 260 switches are planned (as against the roughly 203 of the A300), 280 luminous signals (as against 246), and 30 indicator instruments as against 72. But the cathode screens, in colors, will permit presentation of another 79 instrumental data, therefore giving the crew a greater complex of information than that offered by the present A300. This new technology, made possible by the availability and reliability of today's cathode-ray tubes and microprocessors, could lead to a revolution not only in the technology of flight management of large aircraft but also in their maintenance, in view of the fact that a good part of the research into the causes of troubles could be carried out through the use of synthetic on-board presentation of the technical data from the shop.

Future Programs

The Airbus Industrie group, starting from its now consolidated position in the field of commercial aircraft and in order to ensure to the participating firms a certain continuity of work, does not intend to limit its presence to the sector of medium and short-range wide-body aircraft. Recently announced was the launching of a new version of the A300 that will use the after section designed for the A310 (plus two rows of seats and an LD-3 container), the same integrated pilot's cabin as the 310's, and various refinements of the aerodynamics and of the structures designed to increase the Airbus's carrying capacity. The first step consists in launching the increased-capacity variant of the A300 indicated as the TA.9 (Figure 18), or else a totally new narrow-body aircraft (SA.1, SA.2 or SA.3, depending on its dimensions), or else a long-range, medium-capacity four-engine jet, the TA.11.

Principal Characteristics of the A300 and Its Derivatives

| Dimensions | | A300 | | A310 | | TA9 | | TA11 | | SA1 | | SA2 | |
|--------------------------------|-------|--------|--------|--------|-------|-------|--------|-------|-------|-------|--|-------|--|
| Length | (m) | 53.55 | | 46.66 | | 62.03 | | 48.77 | | 36.12 | | 40.39 | |
| Wing span | (m) | 44.84 | | 43.90 | | 48.80 | | 54.08 | | 34.04 | | 34.04 | |
| Height | (m) | 16.53 | | 15.80 | | 16.74 | | 15.80 | | 12.28 | | 12.35 | |
| | | A300 | | A310 | | TA9 | | TA11 | | SA | | | |
| | | B2-200 | B4-100 | B4-200 | 200 | 300 | 100 | 200 | | 1 | | 2 | |
| MTOW (t) | 142 | 157.5 | 165 | 133 | 140.5 | 162 | 182.4 | 201.5 | 63.6 | 70.8 | | | |
| MZFW (t) | 120.5 | 126 | 126 | 108.5 | 111 | 141 | 151.5 | 131.0 | 54.0 | 61.1 | | | |
| MLW (t) | 130 | 136 | 136 | 118.5 | 120 | 149 | 162.5 | 141.0 | 58.5 | 65.1 | | | |
| Fuel (t) | 34 | 49 | 49 | 43 | 43 | 49 | 59 | 90.35 | 12.6 | 18.8 | | | |
| OWE (t) | 86.6 | 88.5 | 88.8 | 76.1 | 76.8 | 100.2 | 105.34 | 99.73 | 37.83 | 40.86 | | | |
| Commercial payload (t) | 33.9 | 37.5 | 37.2 | 32.4 | 34.2 | 40.8 | 76.16 | 31.27 | 16.17 | 20.24 | | | |
| Capacity in mixed version | 251 | 251 | 251 | 214 | 214 | 313 | 313 | 219 | 122 | 148 | | | |
| Range with full passenger load | 3,350 | 4,950 | 5,500 | 5,000 | 6,200 | 3,400 | 5,700 | 9,800 | 3,700 | 3,900 | | | |

* MTOW: Maximum Takeoff Weight
 MZFW: Maximum Zero-Fuel Weight
 MLW: Maximum Landing Weight
 OWE: Operating Weight Empty

TA.9--Various Airbus customers, especially in the Far East, are already asking for a machine with more capacity than the A300 and using the new technologies. Two versions are planned: one for short runs with high traffic density, with maximum weight similar to that of the current B.4, and the other with longer range and maximum weight close to 180 tons. This machine will make possible approximately a 25-percent increase in capacity, with 313 seats in mixed classes and 340 in the single-class configuration. The engines will still be of the CF6, JT9 or RB.211 families, but with thrust increased to 26,350 kg.

SA--This family of machines, distinguished by the acronym SA (Single-Aisle), is based on a long history of studies carried out by the companies participating in the Airbus group in the 1970's: CAST, European, Group of the Six, X-11-A-205, JET. It seems in a sense to echo the situation of the 1960's when the A300 was trying to take shape. Two basic versions are planned initially: SA.1, with about 130 seats in a single class, and SA.2 with about 150, while SA.3 could reach 180. As for the engines, use of the CFM56 or of

the Anglo-Japanese A2 530 is planned for the former, and for the latter, the JT40 or the CFM56 with increased power. The basic objective is to offer machines with operating costs 20 percent lower than those of the Boeing 727 and almost half the fuel consumption per passenger. These are ambitious objectives, to be sure, but the experience acquired during the development of the preceding projects and the results already demonstrated by the use of the A300 seem to indicate that they can be reached. TA.11--This double-aisle aircraft (TA-Twin Aisle), though, is a long-range plane, with four CFM56 or JT100 engines, designed to operate on runs of 5,500-6,000 miles with about 200 seats in mixed-class configuration. The fuselage would be the basic A310 one, with a different central section, while the wing would--obviously--be entirely new.

The position of the Airbus group, after quite a difficult and contentious startup, is very satisfactory today. Its presence in the world market has developed greatly in recent years, even if one takes into account the launching of the Boeing 767 project. The reasons for this success can be summarized as follows: the A300 is a particularly successful machine from the point of view of both efficiency of use, fuel-consumption economy, noise level and comfort. It has derived also from the effect of the integration of the design, construction and development experience of various large European industries, which has put to rest the definition whereby "the camel is an animal designed by a committee." The presence of several firms and governments in a single program ensures its continuity when the inevitable startup inertia is overcome. The direct interest of the governments of the participating nations can lead to the availability--through banks of national interest--of financing at advantageous rates. This element is especially important in the context of competition with the American industry, which has always enjoyed particularly favorable Eximbank financing. On these bases, the Airbus group is facing the 1980's with confidence. Studies and development for the utilization of advanced technologies (Figures 26, 27 and 28) for the future aircraft of the family of the A300 and derivatives are already under way. The production base is constantly expanding, and it has been possible to demonstrate that integration among aeronautical industries of different nations is a real possibility not only for military programs but also for civilian ones, in which the economic aspects take on predominant importance. It has also been demonstrated that it is possible to broaden participation to new partners, even of smaller size than the Franco-English industry; and I think I may conclude with the hope that Italian industry too can take a place in this European undertaking and demonstrate its strength in this sector as well.

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TRANSPORTATION

MOVE TOWARD LPG-FUELED CARS UNDER WAY

Volvo Contracts With Mobil

Stockholm SVENSKA DAGBLADET in Swedish 14 Aug 80 p 21

[Article by Margareta Artman]

[Text] Goteborg (SvD). Volvo is now concentrating on LPG-fueled cars. Today, the cost advantage of driving LPG-fueled cars will be 75 ore per mile. Within 2 years there will be a network of LPG-equipped gasoline stations all over the country.

All the oil companies are now preparing for LPG installations. Volvo dealers have mainly contract with Mobil Oil, which is consequently collaborating. Volvo also has their own gasoline stations, which are installing LPG equipment in collaboration with Mobil Oil.

The first Volvo gasoline station equipped with LPG is Billa in Solna which began operating last Tuesday.

—Today there are scores of gasoline stations, that belong to different petroleum companies, selling engine fuel, the so-called LPG, says Bo Mikas, Volvobil AB in Goteborg.

Within 2 years the LPG stations will be in the hundreds in the area from Malmö to Luleå. Half of them ventured into joining Volvo's retail chain, which, of course, is a very tempting enterprise.

New Engines

One of the reasons for optimism is that Volvo has now outfitted all '81 models with engines on which LPG units can be installed. The Swedish authorities slowed down the LPG operation earlier, as a car converted to LPG operation has shown worse exhaust emissions than a car driven with gasoline. Now Volvo has solved this problem by effective purification.

Cost 5,500 Kroner

It costs about 5,500 kroner to convert a car to LPG today.

--Compared with other fuels, LPG is without doubt the most quiet and most unarmful to the environment, says Wikas. It is totally free of lead and gasoline and does not leave any dangerous exhaust.

This does not, however, exclude driving with gasoline. The plan is for both fuels to be used, that is to use gasoline when LPG is not available.

In the 240-series 75 ore are saved per mile by driving with LPG. Today, the price is about 1.50 kroner per liter; the tax, which today is favorable, is added to this price. What people worry about is, that the authorities plan to raise the tax on LPG. That would be unfortunate in view of the fact that this is such a pure fuel, thinks Wikas.

The LPG found in Sweden comes mostly from Holland where over 300,000 cars are driven on LPG. Also in Italy LPG is a real alternative to gasoline.

--There are 15,000 Volvo cars, total, that run on LPG-fuel in Europe, says Wikas. Thirty-five percent of the new cars that are delivered to Holland are LPG-equipped.

Great Supplies

The supply is great. In the Persian Gulf alone there is so much surplus gas today, that 20 percent of all the cars in the world could run on the gas from there.

On Volvo's part, Norway's gas extraction is of great interest for the future. Four percent of the extraction from the Norwegian oilfields is directly suitable for LPG.

There are about 60 large Volvo dealers. All install LPG equipment, but smaller gasoline stations are also being considered for installations, says Wikas.

Saab, Esso Develop LPG Car

Stockholm SVENSKA DAGBLADET in Swedish 17 Aug 80 p 22

[Article by Margarete Artsman]

[Text] Goteborg (SvD). Saab intends--just like Volvo--to offer installation of LPG-fuel units in their '81 models, primarily in their five door 900 combination models. If the demand for LPG-fueled cars becomes great, Saab is prepared to start the production of a car of totally new design, undertaken in cooperation with Swedish Esso. Saab will be the only one to do that in the world.

This is a car with a combination tank. Around 20 test cars have been running for some time in Sweden. The experience has been good. Saab will present the new models on 25 August. The LPG-fueling is, however, not considered as great an innovation as certain other revolutionary improvements, according to Saab. There is a great secrecy regarding that, but it is definite that all models will be equipped with a gasoline gauge. Also included in the model program is a new version of the 900 sedan, which was exhibited in Geneva in March, and is now ready for production.

Bengt Landin, manager of Saab's LPG-fueled cars project, says that since 1977 the company has been cooperating with Svenska Esso in a development program.

Esso took the initiative when it became clear that there would be an over production of LPG. Esso also took the initiative that led to a Riksdag's resolution about an unchanged tax relationship between both fuel types. Today, the tax is 68 ore per liter for gas and 1,39 ore for gasoline.

We are prepared to begin production of the new car with the combination tank as soon as we receive an order for 1,000 cars per year. And furthermore, we will be the first, says Lundin.

Instead of installing the extra LPG tank in the trunk, as is now done, this car has a tank with two compartments; one will hold 50 liters of engine fuel, and the other will hold 9-10 liters of gasoline. The car can be fueled from openings on each side. The advantage is that the trunk remains intact.

What Saab is now offering is actually LPG equipped cars in the form of so-called supplementary installation, just as Volvo is doing. Saab is mainly concentrating on the 900 model, which is the combination coupe with five doors, because that car is being used as a taxi.

--The system is the same as Volvo's. The gas unit comes from the Dutch company Landi and the LPG tank is installed in the trunk. In our 900 model it is installed vertically, which means that the backseat can still be pulled down. The LPG then takes up 20 percent of the space.

--The gasbottle holds 48 liters of LPG, which gives a 30 mile cruising range, says Landin. In other words, it consumes more LPG than gasoline. Based on today's prices the saving is 70 ore per mile by using LPG-fuel.

Currently test cars from Peugeot, Opel, Ford, Vaz, etc., are running in Sweden. Those cars cannot be sold yet but it is just a matter of time.

Sten-Ake Forsbergs, Svensk Esso, told SVENSKA DAGBLADET that this forces the building of LPG stations in the country. There are five stations operating so far, two in Stockholm, one in Malmo and Nykobing. Goteborg, Halmstad and Norrkoping are next in line. Within half a year, 25 new stations should be operating.

TRANSPORTATION

FIAT 131 AUTOMOBILE RUNS ON METHANE

Rome L'UNITA in Italian 6 Sep 80 p 4

[Article by Mario Passi: "It Looks Like a Regular Car, But It Runs on Gas from Purification Plants"]

[Excerpt] Cervia--It's a regular FIAT 131, with a white body, a 1,600 cubic centimeter engine with a well-tuned engine sound. There is only one difference: it does not run on gasoline. In the luggage compartment there are 4 gas bottles for a total of 92 liters of methane, which allow for a range of 230 kilometers at a speed of 140 kilometers per hour. This gas cannot be purchased at regular gas stations. It can be obtained at the municipal purification plant in Cervia. In fact, it is called biogas and it is a by-product of the Cervia-Milano Marittima anti-pollution plant. The plant is located at one of the most beautiful tourist centers of the Romagna Riviera, and it is the first to have completed the "mare pulito" (clean sea) operation using an integral cycle plant.

Actually what happens is this: sewer water, instead of being dumped into the ocean, is channeled to a large settling tank. Here the decomposing sludge is removed. This sludge, fed to a "digestor," ferments and produces natural gas. A FIAT plant named Totem burns this gas from which it obtains electricity to run a whole plant in addition to creating a methane surplus sufficient to fuel automobiles for a total of 40,000 kilometers a day.

The FIAT 131, on display in Cervia's Magazzino del Sale, which dates back to the 1600's, is the first car of its kind in Italy to be fueled in such a manner.

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